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(54) SYSTEM AND METHOD FOR PROVIDING TEMPERATURE CONTROL

SYSTEM UND VERFAHREN ZUR TEMPERATURSTEUERUNG

SYSTÈME ET PROCÉDÉ SERVANT À FOURNIR UNE RÉGULATION DE LA TEMPÉRATURE

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Description

TECHNOLOGICAL FIELD

[0001] The presently disclosed subject matter relates to systems and methods for providing temperature control.

PRIOR ART

[0002] References considered to be relevant as background to the presently disclosed subject matter are listed below:

- US 8,123,460
- WO 2014/006309

[0003] Acknowledgement of the above references herein is not to be inferred as meaning that these are in any way relevant to the patentability of the presently disclosed subject matter.

BACKGROUND

[0004] There are many conventional electronic devices such as, for example, computer systems or avionics, and other types of devices, which generate waste heat during operation thereof. For many such devices, proper cooling thereof is essential, otherwise excessive heat generated by the devices can cause malfunctions and failure thereof. However, for at least some types of electronic devices overcooling the device can also potentially damage the devices or affect their proper functioning.

[0005] Many air vehicles, including UAV's and manned vehicles, carry such devices, and conventionally, such devices are often convection cooled.

[0006] In some cases, an air conditioning system is used for providing a controlled temperature environment to such devices by controllably cooling an airflow in a closed-loop arrangement. In other cases a ram air flow is directly heated, and the heated air flow is exclusively injected directly onto the devices to provide the desired temperature control. Such systems often require relatively high levels of power consumption, as well as a significant installation volume and weight.

[0007] By way of general background, in US 2011/0196540 outside air enters a ram air scoop on an aircraft frame, and is ducted to a ram air control valve. The air control valve outputs a desired air mass flow to a cyclone air-water separator which removes moisture and produces a dry air flow. A heater assembly heats the dry air to a desired temperature and directs the heated air into an equipment bay enclosure on the aircraft. The relative humidity of the heated air is sensed by an air moisture sensor which produces a corresponding signal. Other sensors disposed near a payload in the bay enclosure produce corresponding air temperature and air pressure signals. All the sensor signals are input to a processor or controller configured to activate the air control valve and the heater assembly according to set points for temperature and humidity that are specified for the payload in the bay enclosure.

[0008] Also by way of general background, US 2011/0240795 relates to an emergency power system for an aircraft having at least one fuel cell unit for producing electric power, wherein the fuel cell unit is cooled via at least one cooling circuit which includes at least one heat exchanger, and wherein the heat exchanger is connected to at least one air distribution system of the aircraft cabin so that exhaust air heated by the heat exchanger in the operation of the emergency power system can be distributed via the air distribution system in the aircraft cabin.

[0009] Also by way of general background, in US 6,306,032 an aircraft air-conditioning system provides ventilation, air-conditioning and fire protection for a below-deck stairwell and cargo hold that may be equipped with passenger sleeping compartment containers. An air mixing unit mixes fresh air and recycled air to supply mixed air through a first supply air main line and a supply air unit into the freight hold, and through a second supply air main line into the stairwell. A trimming air unit provides hot bleed air from the aircraft engines into the mixed air supplied through the first and second supply air main lines. An exhaust air line extracts exhaust air from the freight hold, while an exhaust air supplemental line extracts exhaust air from the stairwell, both of which are connected to an exhaust air main line with an exhaust air ventilator that blows the exhaust air overboard. A bypass line provides bypass air if needed for the demands of the ventilator. Regulating valves and non-return flap valves in the supply air line and in the exhaust air line regulate the flow of air and prevent back-flow. Temperature sensors are connected to a controller that regulates the temperature of the mixed supply air to achieve a comfortable temperature in the freight hold and in the stairwell. In the event of fire, the air valves are closed, to seal-off the freight hold and prevent the spread of smoke into the stairwell or other ventilated areas.

GENERAL DESCRIPTION

[0010] According to an aspect of the presently disclosed subject matter, there is provided a system for providing a controlled temperature in a control volume, comprising:

a main chamber defining the control volume, and having at least one main chamber inlet and one main chamber outlet;

a mixing chamber having a mixing chamber outlet in selective fluid communication with said main chamber inlet, at least one mixing chamber inlet, and a ram air inlet different from said at least one mixing chamber inlet for allowing a ram airflow at a first tem-

perature to be channeled into said mixing chamber;
a gasflow source in selective fluid communication with said at least one mixing chamber inlet and configured for selectively providing a source gasflow at a second temperature to said mixing chamber, said second temperature being greater than said first temperature;
wherein said mixing chamber is configured for:

- in the presence of said source gasflow in said mixing chamber, selectively allowing said ram airflow and said source gasflow in said mixing chamber to mix therein to provide a mixing chamber outflow to the main chamber (for example via said mixed chamber outlet and said main chamber inlet); or
- in the absence of said source gasflow, selectively allowing said ram airflow in said mixing chamber to flow to the main chamber to thereby provide a mixing chamber outflow;

said mixing chamber outflow being at a third temperature at least at or near said main chamber inlet (for example at entry to said main chamber)
a control system operative to control at least one of said ram airflow, said source gasflow and said mixing chamber outflow to provide a desired said third temperature at least at said main chamber inlet,
wherein, said main chamber comprises an auxiliary outlet, and said gasflow source comprises a recirculation conduit connecting said auxiliary outlet to said mixing chamber inlet and configured for providing a recirculating airflow from said main chamber into the mixing chamber to thereby provide said source gasflow.

[0011] According to an aspect of the presently disclosed subject matter, there is provided a method for providing a controlled temperature in a control volume, as defined in claim 12.

[0012] Further embodiments are defined in the dependent claims.

[0013] A feature of at least some examples of the presently disclosed subject matter is that the cooling airflow, after being heated by heat exchange with the components during passage through the control volume, can be recirculated to the mixing chamber, and thus use can be made of this excess heat. In this manner, the ram air can be effectively heated to the desired temperature (in the mixing chamber) without the need for power to be expended in actively heating the ram airflow. In at least some examples, this can lead to a relatively simple, light system for providing a controlled temperature in the control volume, and having low power consumption. Thus, in at least some examples of the presently disclosed subject matter, the required equipment operation conditions (given a particular environmental air temperature) can be achieved with minimum power consumption, providing power saving. For example, a recirculating conduit can be provided between the control volume and the mixing chamber, and pumps can be used for providing a desired magnitude of recirculated flow of the flow in the control volume that is heated by passage therethrough (i.e., the source gasflow) to the mixing chamber, thereby providing a compact system with low capital cost and low operating costs.

[0014] A feature of at least some examples of the presently disclosed subject matter is that a system for providing a controlled temperature in the control volume can be provided that is simple, robust and of low cost.

[0015] A feature of at least some examples of the presently disclosed subject matter is that a system for providing a controlled temperature in the control volume can be provided that does not require many "moving parts" and for example can thus omit dynamic flappers, flow control valves, shutoff valves, and so on.

[0016] A feature of at least some examples of the presently disclosed subject matter is that a system for providing a controlled temperature in the control volume can be provided in which the desired temperature can be provided by controlling fans that drive the source gasflow into said mixing chamber.

[0017] A feature of at least some examples of the presently disclosed subject matter is that a system for providing a controlled temperature in the control volume can be provided in which there is homogeneity of the cooling flow into the control volume, in particular homogeneity in the temperature of the cooling flow into the control volume.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] In order to better understand the subject matter that is disclosed herein and to exemplify how it may be carried out in practice, examples will now be described, by way of non-limiting example only, with reference to the accompanying drawings, in which:

Fig. 1 is a partial, top-front isometric view of an air vehicle including a system for providing a controlled temperature in a control volume, according to a first example of the presently disclosed subject matter.
Fig. 2 is a partial top-front isometric view of the example of the system of Fig. 1.
Fig. 3 is a partial, detail, top-front isometric view of the mixing chamber of the example of the system of Fig. 1; **Fig. 3(a)** is a cross-sectional side view of the example of Fig. 3.
Fig. 4 is a partial, detail, top-front isometric view of a front part of the example of the system of Fig. 2.
Fig. 5 schematically illustrates the components of the example of the system of Figs. 1 to 4.
Fig. 6 schematically illustrates the components of an alternative variation of the example of the system of Figs. 1 to 4, which does not fall within the scope of the claims.

Fig. 7 schematically illustrates the components of another alternative variation of the example of the system of Figs. 1 to 4, which does not fall within the scope of the claims.

Fig. 8 schematically illustrates the components of another alternative variation of the example of the system of Figs. 1 to 4.

DETAILED DESCRIPTION

[0019] Referring to Figs. 1 to 4, there is illustrated a system for providing a controlled temperature in a predefined volume (referred to herein as the control volume), according to a first example of the presently disclosed subject matter, the system being generally designated with the reference numeral **100.** The system **100** comprises a main chamber **200** defining the control volume V, a mixing chamber **300,** a gasflow source **400,** and a control system **500** (also referred to interchangeably herein as a controller).

[0020] In particular, the system **100** selectively operates as a cooling system, for cooling the control volume **V,** in particular via convection.

[0021] Reference is also made to Fig. 5, which schematically illustrates the components of the system **100,** as disclosed herein.

[0022] The system 100 is particular configured for use in an air vehicle, for example a UAV, but can also be applied to manned vehicles in a similar manner, *mutatis mutandis.*

[0023] In this example, it is desired to regulate the temperature in the control volume **V** so that all parts thereof are kept within a desired temperature range. For example, the control volume **V** contains heat generating components, for example electronic components, that generate heat during operation thereof, and that must or should or that it is desired to be kept within a temperature range **R,** for example between a minimum temperature of about -35° and a maximum temperature of about +55°, to ensure proper working and/or to avoid damaging the components; thus, in this example, it is desired in particular to regulate the temperature in the control volume **V** so that any such heat generating components (e.g. electronic components) therein are kept within the desired temperature range.

[0024] Referring in particular to Fig. 1 and Fig. 2, the main chamber **200** in this example is provided by an internal portion of the forward fuselage **10** of an air vehicle **1** that includes a torsion box **12** and landing gear bay **14.** In this example, the main chamber **200** is generally bounded by the internal walls **210** of the fuselage **10,** the outer wall **230** of the torsion box **12** and the outer wall **240** of the landing gear bay **14,** and having an aft end wall **290.** It is evident, though, that the main chamber **200** can be extended to or defined by aft bay **17,** or that the main chamber **200** can instead be provided elsewhere in the air vehicle **1,** and/or can be provided as a self contained unit independent of the torsion box **12** and/or of the landing gear bay **14** and/or of the inside of the fuselage **10,** as desired or required.

[0025] The main chamber **200** comprises a plurality of main chamber outlets **240,** provided in aft end wall **290,** although in alternative variations of this example, the main chamber **200** comprises one main chamber outlet **240,** in the aft end wall or elsewhere. In any case, the main chamber outlets **240** allow outflow of air flowing out of the main chamber **200** into an aft part of the fuselage **10,** and eventually is ejected from the air vehicle via a suitable vent **18,** for example, or to allow outflow of air flowing out of the main chamber **200** directly out of the air vehicle.

[0026] The main chamber **200** further comprises a number of main chamber inlets **220** to allow airflow into the main chamber **200** from the mixing chamber **300.** In this example, four main chamber inlets **220** are provided, though in alternative variations of this example, one, two, three, or more than four main chamber inlets **220** can be provided instead.

[0027] In this example, the mixing chamber **300** is partly defined by front wall **330a,** rear wall **330b,** and side walls **330c** of the torsion box **12,** and further comprises an upper wall **310** and lower wall **320,** defined by an inside of the fuselage **10,** for example. In alternative variations of this example, the mixing chamber **300** is provided as a self contained unit independent of the torsion box **12** and/or of the inside of the fuselage **10.**

[0028] The mixing chamber **300** comprises a number of mixing chamber outlets **340** in selective fluid communication with the control volume V via the respective main chamber inlets **220.** In this example, the number of mixing chamber outlets **340** is matched to the number of main chamber inlets **220,** so that air flow into the main chamber **200** is exclusively via the mixing chamber **300,** in particular via the mixing chamber outlets **340.** Thus, in this example four mixing chamber outlets **340** are provided, though in alternative variations of this example, one, two, three, or more than four mixing chamber outlets **340** can be provided instead.

[0029] In this example, two of the mixing chamber outlets **340** are in the form of elbow tubings, extending laterally from the side walls **330c** of the mixing chamber **300** (torsion box **12)** and facing generally aft, and two additional mixing chamber outlets **340** are provided on the upper wall **310.**

[0030] Referring to Fig. 2 in particular, each of the mixing chamber outlets **340** includes a controllable variable pump **345.** In this example, each pump **345** is in the form of an electric fan, the operation of which is controlled by control system **500,** and each pump **345** is operatively connected to the control system **500,** represented by line **540** in Fig. 5. In alternative variations of this example, each mixing chamber outlet **340** includes a controllable valve, the operation of each valve being controlled by control system **500,** operatively connected thereto. In yet other alternative variations of this example, the controllable valve, and/or the pump **345,** can be omitted from

system **100.**

[0031] The mixing chamber **300** further comprises at least one mixing chamber inlet **370,** for introducing a gasflow into the mixing chamber **300,** as will become clearer below.

[0032] The mixing chamber **300** further comprises a ram air inlet **360** (see Fig. 4), different from the mixing chamber inlet **370.** A main ram intake **399** is mounted to the front wall **330a** of the mixing chamber **300,** having an intake end **397** and ram conduit **396,** as best seen in Fig. 4. The intake end **397** is provided on an outside of the fuselage **10,** and thus in operation main ram intake **399** is open to atmospheric air. The ram conduit **396** connects the main ram intake **399** to the ram air inlet **360,** and thus the main ram intake is configured for selectively channeling a ram airflow **RA** (i.e., a flow of ram air having a particular mass flow rate or volume flow rate) into the mixing chamber **300** when the air vehicle **1** is in motion. The ram air inlet **360** thus allows the ram airflow **RA** to be channeled into the mixing chamber **300.** The ram airflow **RA** usually provides a cooling airflow to the mixing chamber **300.**

[0033] The mixing chamber **300** can be configured for enhancing mixing of the ram airflow **RA** and the source gasflow **SG,** to promote homogeneity of the mixed chamber outflow **MO.**

[0034] For example, in this example, and as best seen in Figs. 3 and 3(a), the mixing chamber **300** comprises a stagnation plate **301** longitudinally spaced from the ram air inlet **360,** onto which the ram airflow **RA** impinges on entering the mixing chamber, and thereafter disperses in many different directions. The source gasflow **SG** enters the mixing chamber **300** via mixing chamber inlets **370,** which are situated above the stagnation plate **301.** This source gasflow **SG** impinges onto the inside of the front wall **330a,** which also acts as a stagnation plate, and thereafter also disperses in many different directions. Both dispersed flows - the ram airflow **RA** and the source gasflow **SG** - provide high levels of turbulence within the mixing chamber **300,** enhancing mixing of the two flows, to promote homogeneity of the mixed chamber outflow **MO,** and thus promotes homogeneity of the temperature of mixed chamber outflow **MO.** Thus, the cooling air provided to the control volume **V** has an improved homogeneity, particularly in temperature thereof.

[0035] Optionally, and referring to Fig. 5 in particular, the ram conduit **396** includes a controllable variable valve **355,** for example at or near the ram air inlet **360.** For example, the valve **355** is in the form of an electrically operable butterfly valve, the operation of which is controlled by control system **500,** and each valve **355** is operatively connected to the control system **500,** represented by line **560** in Fig. 5. The valve **355** enables the ram airflow **RA** to be regulated by the control system, and even to be shut off entirely when desired. In alternative variations of this example, each mixing chamber outlet **340** includes a controllable pump, the operation of each pump being controlled by control system **500,** operatively connected thereto; such a pump can be selectively used to increase the ram airflow **RA** under certain circumstances.

[0036] The gasflow source **400** is in selective fluid communication with the mixing chamber inlet **370,** and is configured for selectively providing a source gasflow **SG** (i.e., a flow of air or other gas from the gasflow source and having a particular mass flow rate or volume flow rate) to the mixing chamber **300.**

[0037] The gasflow source **400** is in this example comprises a recirculation conduit in the form of a bifurcated duct **420** provided above the landing gear bay **14,** as best seen in Fig. 2, though alternative ducting arrangements can also be used instead. The bifurcated duct **420** has two, aft-disposed branches **425** that join to form a single main duct **426,** at a forward end. The gasflow source **400,** in particular each branch **425** has an inlet **430** (corresponding effectively to an auxiliary outlet provided by the main chamber **200)** at an aft end thereof, open to the main chamber **200.** The main duct **426** includes an elbow section **427** downstream of the branches **425,** and a forward section **429** projecting into the mixing chamber **300.** The elbow section **427** is required in this example to account for the difference in height between the landing gear bay **14** and the mixing chamber **300,** and thus can be omitted in alternative variations of this example in which there is no such difference in height, for example. The forward end of the forward section **429** comprises a pair of openings **421** corresponding to the mixing chamber inlet **370,** each opening **421** including a controllable variable pump **450.** In this example, each pump **450** is in the form of an electric fan, the operation of which is controlled by control system **500,** and each pump **450** is operatively connected to the control system **500,** represented by line **530** in Fig. 5. In at least this example, each pump **450** also effectively operates as a shut off valve, such that when it is not operating the source gasflow **SG** to the mixing chamber is reduced to zero, nominally.

[0038] The recirculation conduit thus essentially connects the inlet **430** (or auxiliary outlet of the main chamber **200)** to the mixing chamber inlet **370** and is configured for providing a recirculating airflow from the main chamber **200** into the mixing chamber **300** to thereby provide the required source gasflow **SG.**

[0039] The gasflow source **400** thus selectively allows a portion **Q** of the air flowing through main chamber **200** (i.e., this portion defining the source gasflow **SG)** to be recirculated back into the mixing chamber **300,** via openings **420,** branches **425,** main duct **426** and openings **421,** selectively drawn from main chamber **200** by the action of the pumps **450.**

[0040] The temperature of the ram airflow **RA,** referred to herein as the first temperature **T1,** is variable, and generally depends on atmospheric conditions as well as the airspeed of the air vehicle **1.** In this example, the flow rate of the ram airflow **RA** also generally depends on atmospheric conditions (for example altitude) as well as the airspeed of the air vehicle **1.** In general, the higher

the flying altitude of the air vehicle, the colder temperature **T1** becomes.

[0041] The temperature of the source gasflow **SG,** referred to herein as the second temperature **T2,** can also vary. In this example, the gasflow source **400** comprises a heat source in the form of a heating system coupled to said recirculation conduit to selectively heat the recirculation airflow to provide a desired second temperature **T2** to the source gasflow **SG.** In this example, the heating system comprises a heater unit **470,** including heating elements configured for controllably heating the source gasflow **SG** to a desired second temperature **T2.** In this example, the heating elements are electrical heating elements coupled to the gasflow source **400,** such as to enable thermal communication and heat exchange between the heating elements and the source gasflow **SG.** In this example, the system **100** can optionally be operated without using the heater unit **470,** in which case the second temperature **T2** corresponds to the temperature of the airflow though the main chamber **200,** at the inlet **430,** and thus the temperature **T2** is attained from the heat generated by the components in the volume **V** and removed therefrom by heat exchange with the mixed airflow **MO.** In alternative variations of this example, the heater unit **470** comprises a combustion system for burning a liquid or gaseous fuel in the source gasflow **SG** to selectively provide heat thereto.

[0042] In yet other alternative variations of this example, the heater unit **470** can be omitted, and thus the second temperature **T2** corresponds to the temperature of the airflow though the main chamber **200,** at the inlet **430,** and thus the temperature **T2** is attained from the heat generated by the components in the volume **V** and removed therefrom by heat exchange with the mixed airflow **MO.**

[0043] The heater unit **470** is operatively connected to the control system **500,** represented by line **550** in Fig. 5.

[0044] The second temperature **T2** thus generally depends on the temperature of the airflow through the main chamber **200,** and/or on operation of the heater unit **470.**

[0045] In general, the second temperature **T2** is greater than the first temperature **T1.**

[0046] In this example, and referring in particular to Fig. 1, a temperature sensor **SA** is provided at or near one of the main chamber inlets **220,** for determining the inlet temperature $\mathbf{T_A}$ in the control volume **V** corresponding to main chamber inlets **220.** In this example, the temperature sensor **SA** is provided in the main chamber **200,** and is operatively connected to the control system **500,** represented by line **510** in Fig. 5.

[0047] Another temperature sensor **SB** is provided at or near one of the main chamber outlets **240,** for determining the outlet temperature $\mathbf{T_B}$ in the control volume **V** corresponding to main chamber outlets **240.** In this example, the temperature sensor **SB** is provided in the main chamber **200,** and is operatively connected to the control system **500,** represented by line **520** in Fig. 5.

[0048] Reference is now made in particular to Fig. 5, which, as already mentioned, schematically illustrates the components of the system **100,** as disclosed above.

[0049] The mixing chamber **300** is configured to operate as follows:

(a) In the presence of the source gasflow **SG** flowing into the mixing chamber **300,** the mixing chamber **300** is configured to selectively allow the ram airflow **RA** (provided via the main ram intake **399)** and the source gasflow **SG** (provided by the gasflow source **400)** in the mixing chamber **300** to continuously mix therein, to thereby provide a mixing chamber outflow **MO** (i.e., a flow of mixed air and/or gas from the mixing chamber and having a particular mass flow rate or volume flow rate) to the main chamber **200** (i.e., via the mixed chamber outlets **340** and the main chamber inlets **220).**

(b) In the absence of said source gasflow **SG,** the mixing chamber **300** is configured to selectively allow the ram airflow **RA** in the mixing chamber **300** (provided via the main ram intake **399)** to continuously flow to the main chamber **200,** to thereby provide a mixing chamber outflow **MO** to the main chamber **200** (i.e., via the mixed chamber outlets **340** and the main chamber inlets **220).**

[0050] In this example, the source gasflow **SG,** as a portion **Q** of the mixing chamber outflow **MO,** can nominally vary between 0% and 100% of said mixing chamber outflow **MO.** For example, with the pump **450** switched off so that nominally the source gasflow **SG** is zero, portion **Q** is 0%. For example, with the ram airflow **RA** at nominally zero (for example: the air vehicle has zero forward speed, for example on the ground; or very little forward speed close to stall; or where the valve **355** is closed and does not allow ram air to enter the mixing chamber), all of the mixing chamber flow **MO** can be recirculated as source gasflow **SG,** and thus portion **Q** is 100%.

[0051] In practice for this example, the system **100** can be set to operate such that this portion **Q** can vary between 0% and 70%, or between 30% and 70% of said mixing chamber outflow **MO.**

[0052] The mixing chamber outflow **MO,** at least at or near the main chamber inlets **220,** is at a third temperature **T3,** the magnitude of which depends on the ratio of the ram airflow **RA** to the source gasflow **SG,** as well as on the first temperature **T1** and the second temperature **T2.**

[0053] The control system **500** comprises any suitable computer system capable of receiving inputs from several sources, for example temperature sensors **SA** and **SB,** and for outputting command signals, for example to one or more of the pumps **345, 450,** valve **355** and heat unit **470,** for operation thereof, according to suitable command algorithms or truth tables programmed in the control system **500,** and as set forth herein for example. Alternatively, the control system **500** can comprise an electronic digital or analog control system, operable in a sim-

ilar manner.

[0054] The control system **500** is operative to control at least one of, and optionally any two of or all three of, the ram airflow **RA,** the source gasflow **SG** (optionally including the temperature **T2** thereof) and the mixing chamber outflow **MO,** to modify the third temperature **T3** at least at or near the main chamber inlets **220,** such as to provide a desired inlet temperature $\mathbf{T_A}$ and/or a desired outlet temperature $\mathbf{T_B}$.

[0055] In particular, the control system **500** is operative to control the third temperature **T3** and the mixing chamber outflow **MO** such that the control volume temperature, i.e., the temperature throughout the control volume **V,** remains within a preset operating temperature range between a preset minimum temperature $\mathbf{T_{min}}$ and a preset maximum temperature $\mathbf{T_{max}}$. For example, the mixing chamber outflow **MO** can be controlled directly via valve **351** and/or pump **345,** or indirectly by controlling the ram airflow **RA** and/or the source gasflow **SG.**

[0056] For example, the preset minimum temperature $\mathbf{T_{min}}$ is -35°C and the preset maximum temperature $\mathbf{T_{max}}$ is about **55°C.** The control volume temperature is determined by one or both of the inlet temperature $\mathbf{T_A}$ corresponding to main chamber inlets **220,** determined by sensor **SA,** and the outlet temperature $\mathbf{T_B}$ corresponding to main chamber outlets **240,** determined by sensor **SB.**

[0057] In at least one mode of operation of the control system **500,** the control system **500** operates to control the ram airflow **RA,** and/or source gasflow **SG** and/or the temperature **T2,** and/or and the mixing chamber outflow **MO,** to maintain the inlet temperature $\mathbf{T_A}$ greater than the preset minimum temperature $\mathbf{T_{min}}$ and/or to maintain the outlet temperature $\mathbf{T_B}$ less than the preset maximum temperature $\mathbf{T_{max}}$. Accordingly, the control system **500** can be programmed with suitable algorithms, with inputs corresponding to one or more of lines **510, 520,** and outputs corresponding to one or more of lines **530, 540, 550, 560** to operate in this manner.

[0058] In one mode of operation, a desired third temperature **T3** is provided by regulating or otherwise controlling the source gasflow **SG** via control system **500,** by controlling the flow rate of the source gasflow **SG** via pumps **450** and/or by controlling the second temperature **T2** thereof via the heating unit **470.** For a fixed mixing chamber outflow **MO,** the higher the flow rate and/or the higher the second temperature **T2** of the source gasflow **SG,** the higher the third temperature **T3** becomes, and thus the higher the inlet temperature $\mathbf{T_A}$ and the higher the outlet temperature $\mathbf{T_B}$, which in turn also increases the second temperature **T2** since the source gasflow **SG** originates from the main chamber **200.** The converse also applies, i.e., for a fixed mixing chamber outflow **MO,** the lower the flow rate and/or the lower the second temperature **T2** of the source gasflow **SG,** the lower the third temperature **T3** becomes. In this mode of operation, the system **100** can omit pumps **345, 360,** and valves **355, 351** and **451,** and optionally also heating unit **470,** so that the control of the temperature **T3** is excursively by operating the pump **450** to provide a desired source gasflow **SG** to mix in the mixing chamber with ram airflow **RA,** thereby regulating the temperature at inlet to the control volume **V.**

[0059] In another mode of operation, a desired third temperature **T3** is provided by regulating or otherwise controlling the mixing chamber outflow **MO** via control system **500,** for example by controlling the flow rate of ram airflow **RA** via valve **355** and/or changing the airspeed and/or altitude of the air vehicle, and/or by controlling the valve **351** and/or pump **345.** For example, for a source gasflow **SG** having a fixed flow rate and/or a fixed second temperature **T2,** the higher the mixing chamber outflow **MO** (which can be increased for example by increasing the ram airflow **RA),** the lower the third temperature **T3** becomes. The converse also applies, i.e., for a source gasflow **SG** having a fixed flow rate and/or a fixed second temperature **T2,** the lower the mixing chamber outflow **MO** (which can be decreased for example by decreasing the ram airflow **RA),** the higher the third temperature **T3** becomes.

[0060] For example, by the control system **500** operating to close the pumps **450,** and thus setting the source gasflow **SG** to zero, the third temperature **T3** is governed by the first temperature **T1,** as well as the magnitude of the mixing chamber outflow **MO,** which is controlled by pumps **345** and/or valve **351.** The pumps **345** and/or valve **351** can also provide a back pressure to the ram airflow **RA,** which thus also affects the magnitude of the ram airflow **RA** into the mixing chamber **300.** As the pumps **345** operate at a higher flow rating and/or as the valve **351** is opened more and more under the control of control system **500,** while the magnitude of the temperature **T3** may not change significantly for a fixed first temperature **T1** (corresponding to constant airspeed and uniform atmospheric conditions), the greater flow rate of the mixing chamber outflow **MO** has a greater impact on the temperature of the main chamber **200.**

[0061] Thus, again for the case of zero source gasflow **SG,** when the temperature in the main chamber **200** (as determined by inlet temperature $\mathbf{T_A}$ or outlet temperature $\mathbf{T_B}$) is higher than temperature **T1,** and it is desired to lower the temperature in the main chamber **200,** the magnitude of the mixing chamber outflow **MO** is controlled by the control system **500** to reduce the measured inlet temperature $\mathbf{T_A}$ or outlet temperature $\mathbf{T_B}$ as desired.

[0062] The system **100** has the added feature that the source gas flow **SG** can be provided and further controlled to further control and fine-tune the temperature within the main chamber **200,** and thus avoid temperatures lower than a desired preset minimum temperature and/or avoid exceeding a preset maximum temperature, anywhere within the control volume **V.** Effectively, this is carried out by mixing relatively warm air of the source gasflow **SG** at second temperature **T2** with the relatively colder air of the ram air flow **RA** at temperature **T1,** to avoid providing very cold air to the control volume **V** when the first temperature **T1** is below the preset minimum

temperature **T_{min}**. In such cases, whenever the temperature **T1** of the ram airflow **RA** is unacceptably low, it can be effectively increased by mixing with the source gasflow **SG** at second temperature **T2.**

[0063] In the example of Figs. 1 to 4, a relatively warm source gasflow **SG** is economically provided by recirculating at least a portion **Q** of the flow through the control volume **V,** which has been heated by the heat generating components therein, for example by operating pump **450.** This arrangement has few moving parts and often requires little power consumption for a large operating range of conditions for the air vehicle.

[0064] Furthermore, an adequate airflow mass flow rate can be provided through the control volume V to provide the required cooling, which can be somewhat independent of the first temperature **T1.** In other words, the system **100** can provide a relatively larger cooling airflow (i.e. mixed outflow **MO)** at a moderately cold temperature **T3** (by mixing relatively warm source gasflow **SG** at second temperature **T2** with colder ram inlet flow **RA** at very low temperature **T1**), as opposed to providing a relatively smaller cooling airflow at (i.e. mixed outflow **MO)** at a relatively colder temperature **T3** (by not providing source gasflow **SG** at second temperature **T2,** and thus the mixed outflow **MO** corresponds to the colder ram inlet flow **RA** at very low temperature **T1**). It is possible that in both cases, the same global heat transfer may be achieved in the control volume **V,** and the same final average temperature may be provided in the cooling volume **V.** However, in the second case, some parts of the control volume **V** could be exposed to the very cold airflow at temperature **T3** that is lower than the preset minimum temperature **T_{min},** while in the first case this can be avoided altogether or the risk thereof significantly minimized by providing a cooling flow that has greater homogeneity in the temperature thereof.

[0065] Optionally, and as illustrated in Fig. 5, the system **100** comprises a first controllable valve **351** operatively connected to the control system **500** and configured for selectively closing the mixing chamber outflow **MO** into the main chamber **200.**

[0066] Optionally, and as illustrated in Fig. 5, the system **100** comprises a second controllable valve **451,** different from the pump **450,** operatively connected to the control system **500** and configured for selectively closing the source gasflow SG into the mixing chamber **300.**

[0067] Thus, the control system **500** selectively operates to deliver a mixing chamber outflow **MO** at a desired third temperature **T3** based at least partially on inlet temperature **T_A** as sensed by the first temperature sensor **SA,** and/or, the control system **500** operates to provide a mixing chamber outflow **MO** at a desired third temperature **T3** based at least partially on outlet temperature **T_B** as sensed by second temperature sensor **SB.**

[0068] Furthermore, the control system **500** selectively operates to increase at least one of the source gasflow **SG,** the second temperature **T2,** and the mixing chamber outflow **MO,** responsive to the inlet temperature **T_A** or the outlet temperature **T_B** reaching the preset minimum temperature **T_{min},** to correspondingly control the third temperature **T3.** Conversely, the control system **500** selectively operates to cease said increase of at least one of the source gasflow, the second temperature, and the mixing chamber outflow **MO,** responsive to said third temperature being significantly above said preset minimum temperature **T_{min}** and in particular exceeding the preset maximum temperature **T_{max}.**

[0069] Furthermore, the control system **500** selectively operates to decrease at least one of the source gasflow **SG** and the second temperature **T2,** and/or to increase the mixing chamber outflow **MO,** responsive to the inlet temperature **T_A** or the outlet temperature **T_B** reaching the preset maximum temperature **T_{max},** to correspondingly control the third temperature **T3.** Furthermore, the control system **500** selectively operates to cease the decrease of at least one of the source gasflow **SG** and the second temperature **T2,** and/or to cease the increase of the mixing chamber outflow **MO,** to the inlet temperature **T_A** or the outlet temperature **T_B** being significantly below the preset maximum temperature **T_{max},** to correspondingly control the third temperature **T3.**

[0070] In an example, there is provided an alternative variation of the example of Figs. **1** to 5, schematically illustrated in Fig. 6, in which the gasflow source **400** comprises an auxiliary ram intake **430A,** instead of the recirculation circuit of Fig. 5. For example, the auxiliary ram intake **430A** comprises an auxiliary intake end provided on an outside of the fuselage **10,** and thus in operation the auxiliary ram intake **430A** is open to atmospheric air. An auxiliary conduit **440A** connects the auxiliary ram intake to the mixing chamber inlet **370** via variable pump **450** and valve **451,** in a similar manner to that disclosed for the example of Fig. 5, *mutatis mutandis*. The auxiliary ram intake **430A** is configured for selectively channeling an atmospheric auxiliary airflow into the mixing chamber **300** to thereby provide the source gasflow **SG.** In the example of Fig. 6, a second heating system **470A** is provided, coupled to the auxiliary conduit **440A** to selectively heat the atmospheric auxiliary airflow channeled by the auxiliary intake **430A,** to provide a desired second temperature **T2** to the source gasflow **SG.** In this example, the source gasflow **SG** is thus independent from the airflow through the main chamber **200.** It is readily evident that the example of Fig. 6 can be modified to add thereto the recirculation circuit of Fig. 5, such that either one or both of the recirculation circuit and the auxiliary ram intake **430A** selectively provide the source gasflow **SG,** as controlled by the control system **500.**

[0071] In another example, there is provided another alternative variation of the example of Figs. 1 to 5, schematically illustrated in Fig. 7, in which the gasflow source **400** comprises a pressurized gas container **430B,** instead of the recirculation circuit of Fig. 5. A container conduit **440B** connects the pressurized gas container **430B** to the mixing chamber inlet **370.** The pressurized gas container **430B** can contain any suitable gas in pres-

surized or liquefied form, for example air, nitrogen, and so on, and is configured for providing a pressurized gasflow into the mixing chamber **300** to thereby provide the required source gasflow **SG.** In the example of Fig. 7, a third heating system **470B** is provided, coupled to the container conduit **440B** to selectively heat the pressurize gasflow, to provide a desired second temperature **T2** to the source gasflow **SG.** In this example, the source gasflow **SG** is thus independent from the airflow through the main chamber **200.** It is readily evident that the example of Fig. 7 can be modified to add the recirculation circuit of Fig. 5, such that either one or both of the recirculation circuit and pressurized gas container **430B** selectively provide the source gasflow **SG,** as controlled by the control system **500.** It is also readily evident that the example of Fig. 7 can be modified to add the auxiliary ram intake **430A** and the auxiliary conduit **440A** and heating system **470A** of the example of Fig. 6, such that either one or both of (a) the pressurized gas container **430B,** and (b) the auxiliary ram intake **430A,** auxiliary conduit **440A** and heating system **470A** of the example of Fig. **6,** selectively provide the source gasflow **SG,** as controlled by the control system **500.**

[0072] In another alternative variation of the example of Figs. 1 to 5, schematically illustrated in Fig. 8, the gasflow source **400** comprises, in addition to the recirculation circuit of Fig. 5, the auxiliary ram intake **430A** and the auxiliary conduit **440A** and heating system **470A** of the example of Fig. 6, as well as the pressurized gas container **430B** and heating system **470B** of the example of Fig. 7. In this example, the control system **500** operates one or more of the elements of the gasflow source **400,** i.e., one or more of (i) recirculation circuit and/or heating system **470,** (ii) the auxiliary ram intake **430A** and/or heating system **470A,** and/or (iii) the pressurized gas container **430B** and heating system **470B,** to provide the desired source gasflow **SG** and desired second temperature **T2.**

[0073] In the method claims that follow, alphanumeric characters and Roman numerals used to designate claim steps are provided for convenience only and do not imply any particular order of performing the steps.

[0074] Finally, it should be noted that the word "comprising" as used throughout the appended claims is to be interpreted to mean "including but not limited to".

[0075] While there has been shown and disclosed examples in accordance with the presently disclosed subject matter, it will be appreciated that many changes may be made therein within the scope of the claims without departing from the presently disclosed subject matter.

Claims

1. System (100) for providing a controlled temperature in a control volume (V), comprising:

    a main chamber (200) defining the control volume (V), and having at least one main chamber inlet (220) and one main chamber outlet (240);
    a mixing chamber (300) having a mixing chamber outlet (340) in selective fluid communication with said main chamber inlet (220), at least one mixing chamber inlet (370), and a ram air inlet (360) different from said at least one mixing chamber inlet (370) for allowing a ram airflow (RA) at a first temperature (T1) to be channeled into said mixing chamber (300);
    a gasflow source (400) in selective fluid communication with said at least one mixing chamber inlet (370) and configured for selectively providing a source gasflow (SG) at a second temperature (T2) to said mixing chamber (300), said second temperature (T2) being greater than said first temperature (T1);
    wherein said mixing chamber (300) is configured for:

    - in the presence of said source gasflow (SG) in said mixing chamber (300), selectively allowing said ram airflow (RA) and said source gasflow (SG) in said mixing chamber (300) to mix therein to provide a mixing chamber outflow (MO) to the main chamber (200); or
    - in the absence of said source gasflow (SG), selectively allowing said ram airflow (RA) in said mixing chamber (300) to flow to the main chamber (200) to thereby provide a mixing chamber outflow (MO);

    said mixing chamber outflow (MO) being at a third temperature (T3) at least at or near said main chamber inlet (220);

    a control system operative to control at least one of said ram airflow (RA), said source gasflow (SG) and said mixing chamber outflow (MO) to provide a desired said third temperature (T3) at least at said main chamber inlet (220);
    wherein said main chamber (200) comprises an auxiliary outlet, and said gasflow source (400) comprises a recirculation conduit connecting said auxiliary outlet to said mixing chamber inlet (370) and configured for providing a recirculating airflow from said main chamber (200) into the mixing chamber (300) to thereby provide said source gasflow (SG).

2. The system according to claim 1, wherein said control system (500) is operative to provide a said third temperature (T3) such as to maintain a temperature in said control volume (V) within a preset operating temperature range between a preset minimum temperature (T_{min}) and a preset maximum temperature (T_{max}).

3. The system (100) according to claim 2, wherein said preset minimum temperature (T_{min}) is -35°C and wherein said preset maximum temperature is +55°C (T_{max}).

4. The system (100) according to any one of claims 1 to 3, comprising one of:

- a first temperature sensor (SA) in said main chamber (200) at or in the vicinity of said main chamber inlet (220), the first temperature sensor (SA) being in operative communication with said control system (500); and
- a first temperature sensor (SA) in said main chamber (200) at or in the vicinity of said main chamber inlet (220), the first temperature sensor (SA) being in operative communication with said control system (500), and, a second temperature sensor (SB) in said main chamber (200) at or in the vicinity of said main chamber outlet (240), the second temperature sensor (SB) being in operative communication with said control system (500).

5. The system (100) according to claim 4, wherein said control system (500) operates to provide said desired third temperature (T3) based at least partially on a sensed inlet temperature (T_A) as sensed by said first temperature sensor (SA) including at least one of the following

- wherein the control system (500) operates to increase at least one of the source gasflow (SG), the second temperature (T2), and the mixing chamber outflow (MO), responsive to one of a sensed inlet temperature (T_A) as sensed by said first temperature sensor (SA) or a sensed outlet temperature (T_B) as sensed by said second temperature sensor (SB) reaching said preset minimum temperature (T_{min});
- wherein the control system (500) operates to increase at least one of the source gasflow (SG), the second temperature (T2), and the mixing chamber outflow (MO), responsive to one of a sensed inlet temperature (T_A) as sensed by said first temperature sensor (SA) or a sensed outlet temperature (T_B) as sensed by said second temperature sensor (SB)reaching said preset minimum temperature (T_{min}), and, wherein the control system (500) operates to cease said increase of at least one of the source gasflow (SG), the second temperature (T2), and the mixing chamber outflow (MO), responsive to one of said sensed inlet temperature (T_A) or said sensed outlet temperature (T_B) being significantly above said preset minimum temperature (T_{min});
- wherein the control system (500) operates to decrease at least one of the source gasflow (SG) and the second temperature (T2), and/or to increase the mixing chamber outflow (MO), responsive to one of said sensed inlet temperature (T_A) or said sensed outlet temperature (T_B) reaching said preset maximum temperature (T_{min});
- wherein the control system (500) operates to decrease at least one of the source gasflow (SG) and the second temperature (T2), and/or to increase the mixing chamber outflow (MO), responsive to one of said sensed inlet temperature (T_A) or said sensed outlet temperature (T_B) reaching said preset maximum temperature (T_{max}), and, wherein the control system (500) operates to cease said decrease of at least one of the source gasflow (SG) and the second temperature (T2), and/or to cease said increase of the mixing chamber outflow (MO), responsive to one of said sensed inlet temperature (T_A) or said sensed outlet temperature (T_B) being significantly below said preset maximum temperature (T_{max}).

6. The system (100) according to any one of claims 1 to 5, comprising at least one of:

- a first controllable variable pump (450?) operatively connected to the control system (500) and configured for controllably varying the magnitude of said source gasflow (SG) into said mixing chamber (300);
- a second controllable variable pump (345) operatively connected to the control system (500) and configured for controllably varying the magnitude of said mixing chamber outflow (MO) into said main chamber (200).

7. The system (100) according to claim 1, including at least one of the following:

- wherein said recirculation airflow is a first proportion of said mixing chamber outflow (MO);
- wherein said recirculation airflow is a first proportion of said mixing chamber outflow (MO), and, wherein said first proportion is between 0% and 100% of said mixing chamber outflow (MO);
- wherein said recirculation airflow is a first proportion of said mixing chamber outflow (MO), and, wherein said first proportion is between 30% and 70% of said mixing chamber outflow (MO).

8. The system (100) according to any one of claims 1 to 7, comprising a first heating system (470) coupled to said recirculation conduit to selectively heat said recirculation airflow to provide a desired said second temperature (T2) to said source gasflow (SG).

9. The system (100) according to any one of claims 1 to 8, including at least one of:

- wherein said gasflow source (400) comprises an auxiliary ram intake (430A), in operation thereof being open to atmospheric air, and an auxiliary conduit (440A) connecting said auxiliary ram intake (430A) to said mixing chamber inlet (370), wherein said auxiliary ram intake (430A) is configured for selectively channeling an atmospheric auxiliary airflow into the mixing chamber (300) to thereby provide said source gasflow (SG);
- wherein said gasflow source (400) comprises an auxiliary ram intake (430A), in operation thereof being open to atmospheric air, and an auxiliary conduit (440A) connecting said auxiliary ram intake (430A) to said mixing chamber inlet (370), wherein said auxiliary ram intake (430A) is configured for selectively channeling an atmospheric auxiliary airflow into the mixing chamber (300) to thereby provide said source gasflow (SG), and, comprising a second heating system (470A) coupled to said auxiliary conduit (440A) to selectively heat said atmospheric auxiliary airflow to provide a desired said second temperature (T2) to said source gasflow (SG);
- wherein said gasflow source (400) comprises a pressurized gas container (430B), and a container conduit (440B) connecting said pressurized gas container (430B) to said mixing chamber inlet (370) and configured for providing a pressurized gasflow into the mixing chamber to thereby provide said source gasflow (SG);
- wherein said gasflow source (400) comprises a pressurized gas container (430B), and a container conduit (440B) connecting said pressurized gas container (430B) to said mixing chamber inlet (370) and configured for providing a pressurized gasflow into the mixing chamber (300) to thereby provide said source gasflow (SG), and, comprising a third heating system (470B) coupled to said container conduit (440B) to selectively heat said pressurized gasflow to provide a desired said second temperature (T2) to said source gasflow (SG);
- wherein said main chamber (200) accommodates electronic components;
- wherein said main chamber (200) accommodates electronic components, and wherein said components are operational within said preset temperature range.

10. The system (100) according to any one of claims 1 to 9, further comprising a main ram intake (399), in operation thereof being open to atmospheric air, and a ram conduit (396) connecting said main ram intake (399) to said ram air inlet (360), wherein said main ram intake (399) is configured for selectively channeling said ram airflow (RA) into said mixing chamber (300).

11. An air vehicle comprising the system (100) as defined in any one of claims 1 to 10, and wherein optionally the air vehicle is a UAV.

12. Method for providing a controlled temperature in a control volume (V), the control volume (V) being defined by a main chamber (200) having at least one main chamber inlet (220), a main chamber outlet (240), and an auxiliary outlet, the method comprising:

(A) providing a ram airflow (RA) at a first temperature (T1) into a mixing chamber (300) via a ram air inlet (360), the mixing chamber (300) having a mixing chamber outlet (340) in selective fluid communication with the main chamber inlet (220), and at least one mixing chamber inlet (370), and wherein the ram air inlet (360) is different from the at least one mixing chamber inlet (370);
(B) selectively providing a source gasflow (SG) at a second temperature (T2) into said mixing chamber (300), said second temperature (T2) being greater than said first temperature (T1); and wherein:

- in the presence of said source gasflow (SG) in said mixing chamber (300), selectively allowing said ram airflow (RA) and said source gasflow (SG) in said mixing chamber (300) to mix therein to provide a mixing chamber outflow (MO) to the control volume (V); or
- in the absence of said source gasflow (SG), selectively allowing said ram airflow (RA) in said mixing chamber (300) to flow to the control volume (V) to thereby provide a mixing chamber outflow (MO);

said mixing chamber outflow (MO) being at a third temperature (T3) at least at or near entry to the control volume (V);

(C) controlling at least one of said ram airflow (RA), said source gasflow (SG) and said mixing chamber outflow (MO) to provide a desired said third temperature (T3) at least at or near entry to the control volume (V); and
(D) providing a recirculating airflow from the control volume (V) into the mixing chamber (300) via a recirculation conduit to thereby provide said source gasflow (SG), wherein said recirculation conduit connects said auxiliary outlet to said mixing chamber inlet (370).

13. The method according to claim 12, including at least one of the following:

- wherein said third temperature (T3) such as to maintain a temperature in said control volume (V) within a preset operating temperature (R?) range between a preset minimum temperature (T_{min}) and a preset maximum temperature (T_{max});
- wherein said third temperature (T3) such as to maintain a temperature in said control volume (V) within a preset operating temperature range (R?) between a preset minimum temperature (T_{min}) and a preset maximum temperature (T_{max}), and, wherein said preset minimum temperature (T_{min}) is -35°C and wherein said preset maximum temperature (T_{max}) is +55°C.

14. The method according to any one of claims 12 to 13, including at least one of the following:

- providing a heating source and, using the heating source, controllably heating said source gasflow (SG) to a desired said second temperature (T2);
- providing a desired said third temperature (T3) based at least partially on a sensed inlet temperature (T_A) as sensed at or in the vicinity of an inlet of the control volume (V);
- providing a desired said third temperature (T3) based at least partially on a sensed outlet temperature (T_B) as sensed at or in the vicinity of an outlet of the control volume (V);
- providing a desired said third temperature (T3) based at least partially on a sensed outlet temperature (T_B) as sensed at or in the vicinity of an outlet of the control volume (V), and, increasing at least one of the source gasflow (SG), the second temperature (T2), and the mixing chamber outflow (MO), responsive to one of said sensed inlet temperature (T_A) or said sensed outlet temperature (T_B) reaching said preset minimum temperature (T_{min});
- providing a desired said third temperature (T3) based at least partially on a sensed outlet temperature (T_B) as sensed at or in the vicinity of an outlet of the control volume (V), and, increasing at least one of the source gasflow (SG), the second temperature (T2), and the mixing chamber outflow (MO), responsive to one of said sensed inlet temperature (T_A) or said sensed outlet temperature (T_B) reaching said preset minimum temperature (T_{min}), and, ceasing said increase of at least one of the source gasflow (SG), the second temperature (T2), and the mixing chamber outflow (MO), responsive to one of said sensed inlet temperature (T_A) or said sensed outlet temperature (T_B) being significantly above said preset minimum temperature (T_{min});
- providing a desired said third temperature (T3) based at least partially on a sensed outlet temperature (T_B) as sensed at or in the vicinity of an outlet of the control volume (V), and, decreasing at least one of the source gasflow (SG) and the second temperature (T2), and/or to increase the mixing chamber outflow (MO), responsive to one of said sensed inlet temperature (T_A) or said sensed outlet temperature (T_B) reaching said preset maximum temperature (T_{max});
- providing a desired said third temperature (T3) based at least partially on a sensed outlet temperature (T_B) as sensed at or in the vicinity of an outlet of the control volume (V), and, decreasing at least one of the source gasflow (SG) and the second temperature (T2), and/or to increase the mixing chamber outflow (MO), responsive to one of said sensed inlet temperature (T_A) or said sensed outlet temperature (T_B) reaching said preset maximum temperature (T_{max}), and, ceasing said decrease of at least one of the source gasflow (SG) and the second temperature (T2), and/or to cease said increase of the mixing chamber outflow (MO), responsive to one of said sensed inlet temperature (T_A) or said sensed outlet temperature (T_B) being significantly below said preset maximum temperature (T_{max});
- controllably varying the magnitude of said source gasflow (SG) into said mixing chamber (300);
- controllably varying the magnitude of said mixing chamber outflow (MO) into the control volume (V);
- selectively channeling an atmospheric auxiliary airflow into the mixing chamber (300), different from said ram, airflow (RA), to thereby provide said source gasflow (SG);
- providing a pressurized gasflow into the mixing chamber (300) to thereby provide said source gasflow (SG);
- wherein the control volume (V) accommodates electronic components.

15. The method according to claim 12, wherein said recirculation airflow is a first proportion of said mixing chamber outflow (MO), and wherein said first proportion is between 30% and 70% of said mixing chamber outflow (MO).

Patentansprüche

1. System (100) zum Bereitstellen einer geregelten Temperatur in einem Steuervolumen (V), das Folgendes umfasst:

eine Hauptkammer (200), die das Steuervolumen (V) definiert und wenigstens einen Hauptkammereinlass (220) und einen Hauptkammerauslass (240) aufweist;
eine Mischkammer (300) mit einem Mischkammerauslass (340) in selektiver Fluidverbindung mit dem genannten Hauptkammereinlass (220), wenigstens einem Mischkammereinlass (370) und einem Staulufteinlass (360), der sich von dem genannten wenigstens einen Mischkammereinlass (370) unterscheidet, um das Leiten eines Stauluftstroms (RA) mit einer ersten Temperatur (T1) in die genannte Mischkammer (300) zuzulassen;
eine Gasstromquelle (400) in selektiver Fluidverbindung mit dem genannten wenigstens einen Mischkammereinlass (370), konfiguriert zum selektiven Bereitstellen eines Quellgasstroms (SG) mit einer zweiten Temperatur (T2) zu der genannten Mischkammer (300), wobei die genannte zweite Temperatur (T2) höher ist als die genannte erste Temperatur (T1) ;
wobei die genannte Mischkammer (300) konfiguriert ist zum:

- selektiven Zulassen, in Anwesenheit des genannten Quellgasstroms (SG) in der genannten Mischkammer (300), dass sich der genannte Stauluftstrom (RA) und der genannte Quellgasstrom (SG) in der genannten Mischkammer (300) darin mischen, um einen Mischkammerausfluss (MO) in die Hauptkammer (200) bereitzustellen; oder
- selektiven Zulassen, in Abwesenheit des genannten Quellgasstroms (SG), dass der genannte Stauluftstrom (RA) in der genannten Mischkammer (300) zur Hauptkammer (200) fließt, um dadurch einen Mischkammerausfluss (MO) bereitzustellen;

wobei der genannte Mischkammerausfluss (MO) auf einer dritten Temperatur (T3) wenigstens an oder nahe dem genannten Hauptkammereinlass (220) ist;
ein Steuersystem mit der Aufgabe, wenigstens eines aus dem genannten Stauluftstrom (RA), dem genannten Quellgasstrom (SG) und dem genannten Mischkammerausfluss (MO) zu steuern, um eine gewünschte genannte dritte Temperatur (T3) wenigstens an dem genannten Hauptkammereinlass (220) bereitzustellen;
wobei die genannte Hauptkammer (200) einen Nebenauslass umfasst und die genannte Gasstromquelle (400) eine Rezirkulationsleitung umfasst, die den genannten Nebenauslass mit dem genannten Mischkammereinlass (370) verbindet und zum Bereitstellen eines Rezirkulationsluftstroms von der genannten Hauptkammer (200) in die Mischkammer (300) konfiguriert ist, um dadurch den genannten Quellgasstrom (SG) bereitzustellen.

2. System nach Anspruch 1, wobei das genannte Steuersystem (500) die Aufgabe hat, eine genannte dritte Temperatur (T3) bereitzustellen, um eine Temperatur in dem genannten Steuervolumen (V) innerhalb eines voreingestellten Betriebstemperaturbereichs zwischen einer voreingestellten Mindesttemperatur (T_{min}) und einer voreingestellten Höchsttemperatur (T_{max}) zu halten.

3. System (100) nach Anspruch 2, wobei die genannte voreingestellte Mindesttemperatur (T_{min}) -35°C ist und wobei die genannte voreingestellte Höchsttemperatur +55°C (T_{max}) ist.

4. System (100) nach einem der Ansprüche 1 bis 3, das eines der Folgenden umfasst:

- einen ersten Temperatursensor (SA) in der genannten Hauptkammer (200) an oder nahe dem genannten Hauptkammereinlass (220), wobei der erste Temperatursensor (SA) in operativer Kommunikation mit dem genannten Steuersystem (500) ist; und
- einen ersten Temperatursensor (SA) in der genannten Hauptkammer (200) an oder nahe dem genannten Hauptkammereinlass (220), wobei der erste Temperatursensor (SA) in operativer Kommunikation mit dem genannten Steuersystem (500) ist, und einen zweiten Temperatursensor (SB) in der genannten Hauptkammer (200) an oder nahe dem genannten Hauptkammerauslass (240), wobei der zweite Temperatursensor (SB) in operativer Kommunikation mit dem genannten Steuersystem (500) ist.

5. System (100) nach Anspruch 4, wobei das genannte Steuersystem (500) die Aufgabe hat, die genannte gewünschte dritte Temperatur (T3) wenigstens teilweise auf der Basis einer erfassten Einlasstemperatur (T_A) zu erzielen, erfasst durch den genannten ersten Temperatursensor (SA), einschließlich wenigstens eines der Folgenden:

- wobei das Steuersystem (500) die Aufgabe hat, wenigstens eines aus dem Quellgasstrom (SG), der zweiten Temperatur (T2) und dem Mischkammerausfluss (MO) als Reaktion darauf, dass eine erfasste Einlasstemperatur (T_A), erfasst durch den genannten ersten Temperatursensor (SA), oder eine erfasste Auslasstemperatur (T_B), erfasst durch den zweiten Temperatursensor (SB), die genannte voreingestellte Mindesttemperatur (T_{min}) erreicht, zu erhöhen;
- wobei das Steuersystem (500) die Aufgabe

hat, wenigstens eines aus einem Quellgasstrom (SG), der zweiten Temperatur (T2) und dem Mischkammerausfluss (MO) als Reaktion darauf, dass eine erfasste Einlasstemperatur (T_A), erfasst durch den genannten ersten Temperatursensor (SA), oder eine erfasste Auslasstemperatur (T_B), erfasst durch den genannten zweiten Temperatursensor (SB), die genannte voreingestellte Mindesttemperatur (T_{min}) erreicht, zu erhöhen, und wobei das Steuersystem (500) die Aufgabe hat, die genannte Erhöhung von wenigstens einem aus dem Quellgasstrom (SG), der zweiten Temperatur (T2) und dem Mischkammerausfluss (MO) als Reaktion darauf zu stoppen, dass die genannte erfasste Einlasstemperatur (T_A) oder die genannte erfasste Auslasstemperatur (T_B) signifikant über der genannten voreingestellten Mindesttemperatur (T_{min}) liegt;

- wobei das Steuersystem (500) die Aufgabe hat, den Quellgasstrom (SG) und/oder die zweite Temperatur (T2) zu verringern und/oder den Mischkammerausfluss (MO) zu erhöhen, als Reaktion darauf, dass die genannte erfasste Einlasstemperatur (T_A) oder die genannte erfasste Auslasstemperatur (T_B) die genannte voreingestellte Höchsttemperatur (T_{min}) erreicht;
- wobei das Steuersystem (500) die Aufgabe hat, den Quellgasstrom (SG) und/oder die zweite Temperatur (T2) zu verringern und/oder den Mischkammerausfluss (MO) zu erhöhen, als Reaktion darauf, dass die genannte erfasste Einlasstemperatur (T_A) oder die genannte erfasste Auslasstemperatur (T_B) die genannte voreingestellte Höchsttemperatur (T_{max}) erreicht, und wobei das Steuersystem (500) die Aufgabe hat, die genannte Verringerung des Quellgasstroms (SG) und/oder der zweiten Temperatur (T2) zu stoppen und/oder die genannte Erhöhung des Mischkammerausflusses (MO) zu stoppen, als Reaktion darauf, dass die genannte erfasste Einlasstemperatur (T_A) oder die genannte erfasste Auslasstemperatur (T_B) signifikant unter der genannten voreingestellten Höchsttemperatur (T_{max}) liegt.

6. System (100) nach einem der Ansprüche 1 bis 5, das wenigstens eines der Folgenden umfasst:

- eine erste steuerbare variable Pumpe (450?), die operativ mit dem Steuersystem (500) verbunden und zum steuerbaren Variieren der Größe des genannten Quellgasstroms (SG) in die genannte Mischkammer (300) konfiguriert ist;
- eine zweite steuerbare variable Pumpe (345), die operativ mit dem Steuersystem (500) verbunden und zum steuerbaren Variieren der Größe des genannten Mischkammerausflusses (MO) in die genannte Hauptkammer (200) konfiguriert ist.

7. System (100) nach Anspruch 1, das wenigstens eines der Folgenden beinhaltet:

- wobei der genannte Rezirkulationsluftstrom ein erster Anteil des genannten Mischkammerausflusses (MO) ist;
- wobei der genannte Rezirkulationsluftstrom ein erster Anteil des genannten Mischkammerausflusses (MO) ist und wobei der genannte erste Anteil zwischen 0 % und 100 % des genannten Mischkammerausflusses (MO) liegt;
- wobei der genannte Rezirkulationsluftstrom ein erster Anteil des genannten Mischkammerausflusses (MO) ist und wobei der genannte erste Anteil zwischen 30 % und 70 % des genannten Mischkammerausflusses (MO) liegt.

8. System (100) nach einem der Ansprüche 1 bis 7, das ein erstes Heizsystem (470) umfasst, das mit der genannten Rezirkulationsleitung gekoppelt ist, um den genannten Rezirkulationsluftstrom selektiv zu erhitzen, um eine gewünschte genannte zweite Temperatur (T2) für den genannten Quellgasstrom (SG) zu erzielen.

9. System (100) nach einem der Ansprüche 1 bis 8, das wenigstens eines der Folgenden beinhaltet:

- wobei die genannte Gasstromquelle (400) einen Nebenstaulufteinlauf (430A) umfasst, der bei seinem Betrieb zur atmosphärischen Luft hin offen ist, und eine Nebenleitung (440A), die den genannten Nebenstaulufteinlauf (430A) mit dem genannten Mischkammereinlass (370) verbindet, wobei der genannte Nebenstaulufteinlauf (430A) zum selektiven Leiten eines atmosphärischen Nebenluftstroms in die Mischkammer (300) konfiguriert ist, um dadurch den genannten Quellgasstrom (SG) bereitzustellen;
- wobei die genannte Gasstromquelle (400) einen Nebenstaulufteinlauf (430A) umfasst, der bei seinem Betrieb gegenüber der atmosphärischen Luft offen ist, und eine Nebenleitung (440A), die den genannten Nebenstaulufteinlauf (430A) mit dem genannten Mischkammereinlass (370) verbindet, wobei der genannte Nebenstaulufteinlauf (430A) zum selektiven Leiten eines atmosphärischen Nebenluftstroms in die Mischkammer (300) konfiguriert ist, um dadurch den genannten Quellgasstrom (SG) bereitzustellen, und ein zweites Heizsystem (470A) umfasst, das mit der genannten Nebenleitung (440A) gekoppelt ist, um den genannten atmosphärischen Nebenluftstrom selektiv zu erhitzen,

um eine gewünschte genannte zweite Temperatur (T2) für den genannten Quellgasstrom (SG) zu erzielen;
- wobei die genannte Gasstromquelle (400) einen Druckgascontainer (430B) und eine Containerleitung (440B) umfasst, die den genannten Druckgascontainer (430B) mit dem genannten Mischkammereinlass (370) verbindet und zum Bereitstellen eines Druckgasstroms in die Mischkammer konfiguriert ist, um dadurch den genannten Quellgasstrom (SG) bereitzustellen;
- wobei die genannte Gasstromquelle (400) einen Druckgascontainer (430B) und eine Containerleitung (440B) umfasst, die den genannten Druckgascontainer (430B) mit dem genannten Mischkammereinlass (370) verbindet und zum Bereitstellen eines Druckgasstroms in die Mischkammer (300) konfiguriert ist, um dadurch den genannten Quellgasstrom (SG) bereitzustellen, und ein drittes Heizsystem (470B) umfasst, das mit der genannten Containerleitung (440B) gekoppelt ist, um den genannten Druckgasstrom selektiv zu erhitzen, um eine gewünschte genannte zweite Temperatur (T2) für den genannten Quellgasstrom (SG) bereitzustellen;
- wobei die genannte Hauptkammer (200) elektronische Komponenten aufnimmt;
- wobei die genannte Hauptkammer (200) elektronische Komponenten aufnimmt und wobei die genannten Komponenten innerhalb des genannten voreingestellten Temperaturbereichs arbeiten.

10. System (100) nach einem der Ansprüche 1 bis 9, das ferner einen Hauptstaulufteinlauf (399) umfasst, der bei seinem Betrieb zur atmosphärischen Luft hin offen ist, und eine Stauluftleitung (396), die den genannten Hauptstaulufteinlauf (399) mit dem genannten Staulufteinlass (360) verbindet, wobei der genannte Hauptstaulufteinlauf (399) zum selektiven Leiten des genannten Stauluftstroms (RA) in die genannte Mischkammer (300) konfiguriert ist.

11. Luftfahrzeug, das das System (100) nach einem der Ansprüche 1 bis 10 umfasst, wobei das Luftfahrzeug optional ein UAV ist.

12. Verfahren zum Bereitstellen einer geregelten Temperatur in einem Steuervolumen (V), wobei das Steuervolumen (V) durch eine Hauptkammer (200) mit wenigstens einem Hauptkammereinlass (220), einem Hauptkammerauslass (240) und einem Nebenauslass definiert wird, wobei das Verfahren Folgendes beinhaltet:

(A) Bereitstellen eines Stauluftstroms (RA) mit einer ersten Temperatur (T1) in eine Mischkammer (300) über einen Staulufteinlass (360), wobei die Mischkammer (300) einen Mischkammerauslass (340) in selektiver Fluidverbindung mit dem Hauptkammereinlass (220) und wenigstens einem Mischkammereinlass (370) ist, und wobei sich der Staulufteinlass (360) von dem wenigstens einen Mischkammereinlass (370) unterscheidet;
(B) selektives Bereitstellen eines Quellgasstroms (SG) mit einer zweiten Temperatur (T2) in die genannte Mischkammer (300), wobei die genannte zweite Temperatur (T2) höher ist als die genannte erste Temperatur (T1); und wobei:

- in Anwesenheit des genannten Quellgasstroms (SG) in der genannten Mischkammer (300) ein Mischen des genannten Stauluftstroms (RA) und des genannten Quellgasstroms (SG) in der genannten Mischkammer (300) selektiv zugelassen wird, um einen Mischkammerausfluss (MO) zum Steuervolumen (V) bereitzustellen; oder
- in Abwesenheit des genannten Quellgasstroms (SG) ein Fließen des genannten Stauluftstroms (RA) in die genannte Mischkammer (300) zum Steuervolumen (V) selektiv zugelassen wird, um dadurch einen Mischkammerausfluss (MO) bereitzustellen;
wobei der genannte Mischkammerausfluss (MO) auf einer dritten Temperatur (T3) wenigstens an oder nahe dem Eingang zum Steuervolumen (V) ist;

(C) Steuern von wenigstens einem aus dem genannten Stauluftstrom (RA), dem genannten Quellgasstrom (SG) und dem genannten Mischkammerausfluss (MO), um eine gewünschte genannte dritte Temperatur (T3) wenigstens an oder nahe dem Eingang zum Steuervolumen (V) zu erzielen; und
(D) Bereitstellen eines Rezirkulationsluftstroms vom Steuervolumen (V) in die Mischkammer (300) über eine Rezirkulationsleitung, um dadurch den genannten Quellgasstrom (SG) bereitzustellen, wobei die genannte Rezirkulationsleitung den genannten Nebenauslass mit dem genannten Mischkammereinlass (370) verbindet.

13. Verfahren nach Anspruch 12, das wenigstens eines der Folgenden beinhaltet:

- wobei die genannte dritte Temperatur (T3) zum Halten einer Temperatur in dem genannten Steuervolumen (V) innerhalb eines voreingestellten Betriebstemperaturbereichs (R?) zwischen einer voreingestellten Mindesttemperatur

(T_{min}) und einer voreingestellten Höchsttemperatur (T_{max}) liegt;
- wobei die genannte dritte Temperatur (T3) zum Halten einer Temperatur in dem genannten Steuervolumen (V) innerhalb eines voreingestellten Betriebstemperaturbereichs (R?) zwischen einer voreingestellten Mindesttemperatur (T_{min}) und einer voreingestellten Höchsttemperatur (T_{max}) liegt, und wobei die genannte voreingestellte Mindesttemperatur (T_{min}) - 35°C beträgt und wobei die genannte voreingestellte Höchsttemperatur (T_{max}) +55°C beträgt.

14. Verfahren nach einem der Ansprüche 12 bis 13, das wenigstens eines der Folgenden beinhaltet:

- Bereitstellen einer Heizquelle und Benutzen der Heizquelle zum steuerbaren Erhitzen des genannten Quellgasstroms (SG) auf eine gewünschte genannte zweite Temperatur (T2);
- Bereitstellen einer gewünschten genannten dritten Temperatur (T3) wenigstens teilweise auf der Basis einer erfassten Einlasstemperatur (T_A), erfasst an oder nahe einem Einlass des Steuervolumens (V);
- Bereitstellen einer gewünschten genannten dritten Temperatur (T3) wenigstens teilweise auf der Basis einer erfassten Auslasstemperatur (T_B), erfasst an oder nahe einem Auslass des Steuervolumens (V);
- Bereitstellen einer gewünschten genannten dritten Temperatur (T3) wenigstens teilweise auf der Basis einer erfassten Auslasstemperatur (T_B), erfasst an oder nahe einem Auslass des Steuervolumens (V), und Erhöhen wenigstens eines aus dem Quellgasstrom (SG), der zweiten Temperatur (T2) und dem Mischkammerausfluss (MO) als Reaktion darauf, dass die genannte erfasste Einlasstemperatur (T_A) oder die genannte erfasste Auslasstemperatur (T_B) die genannte voreingestellte Mindesttemperatur (T_{min}) erreicht;
- Bereitstellen einer gewünschten genannten dritten Temperatur (T3) wenigstens teilweise auf der Basis einer erfassten Auslasstemperatur (T_B), erfasst an oder nahe einem Auslass des Steuervolumens (V), und Erhöhen wenigstens eines aus dem Quellgasfluss (SG), der zweiten Temperatur (T2) und dem Mischkammerausfluss (MO) als Reaktion darauf, dass die genannte erfasste Einlasstemperatur (T_A) oder die genannte erfasste Auslasstemperatur (T_B) die genannte voreingestellte Mindesttemperatur (T_{min}) erreicht, und Stoppen des genannten Erhöhens von wenigstens einem aus dem Quellgasfluss (SG), der zweiten Temperatur (T2) und dem Mischkammerausfluss (MO) als Reaktion darauf, dass die genannte erfasste Einlasstemperatur (T_A) oder die genannte erfasste Auslasstemperatur (T_B) signifikant über der genannten voreingestellten Mindesttemperatur (T_{min}) liegt;
- Bereitstellen einer gewünschten genannten dritten Temperatur (T3) wenigstens teilweise auf der Basis einer erfassten Auslasstemperatur (T_B), erfasst an oder nahe einem Auslass des Steuervolumens (V), und Verringern des Quellgasstroms (SG) und/oder der zweiten Temperatur (T2), und/oder Erhöhen des Mischkammerausflusses (MO), als Reaktion darauf, dass die genannte erfasste Einlasstemperatur (T_A) oder die genannte erfasste Auslasstemperatur (T_B) die genannte voreingestellte Höchsttemperatur (T_{max}) erreicht;
- Bereitstellen einer gewünschten genannten dritten Temperatur (T3) wenigstens teilweise auf der Basis einer erfassten Auslasstemperatur (T_B), erfasst an oder nahe einem Auslass des Steuervolumens (V), und Verringern des Quellgasstroms (SG) und/oder der zweiten Temperatur (T2), und/oder Erhöhen des Mischkammerausflusses (MO), als Reaktion darauf, dass die genannte erfasste Einlasstemperatur (T_A) oder die genannte erfasste Auslasstemperatur (T_B) die genannte voreingestellte Höchsttemperatur (T_{max}) erreicht, und Stoppen der genannten Verringerung des Quellgasstroms (SG) und/oder der zweiten Temperatur (T2), und/oder Stoppen der genannten Erhöhung des Mischkammerausflusses (MO), als Reaktion darauf, dass die genannte erfasste Einlasstemperatur (T_A) oder die genannte erfasste Auslasstemperatur (T_B) signifikant unter der genannten voreingestellten Höchsttemperatur (T_{max}) liegt;
- steuerbares Variieren der Größe des genannten Quellgasstroms (SG) in die genannte Mischkammer (300);
- steuerbares Variieren der Größe des genannten Mischkammerausflusses (MO) in das Steuervolumen (V);
- selektives Leiten eines atmosphärischen Nebenluftstroms in die Mischkammer (300), der sich von dem genannten Stauluftstrom (RA) unterscheidet, um dadurch den genannten Quellgasstrom (SG) bereitzustellen;
- Bereitstellen eines Druckgasstroms in die Mischkammer (300), um dadurch den genannten Quellgasstrom (SG) bereitzustellen;
- wobei das Steuervolumen (V) elektronische Komponenten aufnimmt.

15. Verfahren nach Anspruch 12, wobei der genannte Rezirkulationsluftstrom ein erster Anteil des genannten Mischkammerausflusses (MO) ist und wobei der genannte erste Anteil zwischen 30 % und 70 % des genannten Mischkammerausflusses (MO) liegt.

Revendications

1. Système (100) servant à fournir une température contrôlée dans un volume de contrôle (V), comportant :

une chambre principale (200) définissant le volume de contrôle (V), et ayant au moins une entrée de chambre principale (220) et une sortie de chambre principale (240) ;
une chambre de mélange (300) ayant une sortie de chambre de mélange (340) en communication fluidique sélective avec ladite entrée de chambre principale (220), au moins une entrée de chambre de mélange (370), et une entrée d'air dynamique (360) différente par rapport à ladite au moins une entrée de chambre de mélange (370) pour permettre à un écoulement d'air dynamique (RA) à une première température (T1) d'être acheminé jusque dans ladite chambre de mélange (300) ;
une source d'écoulement de gaz (400) en communication fluidique sélective avec ladite au moins une entrée de chambre de mélange (370) et configurée pour fournir de manière sélective un écoulement de gaz de source (SG) à une deuxième température (T2) jusque dans ladite chambre de mélange (300), ladite deuxième température (T2) étant supérieure par rapport à ladite première température (T1) ;
dans lequel ladite chambre de mélange (300) est configurée pour :

- en présence dudit écoulement de gaz de source (SG) dans ladite chambre de mélange (300), permettre de manière sélective audit écoulement d'air dynamique (RA) et audit écoulement de gaz de source (SG) dans ladite chambre de mélange (300) de se mélanger dans celle-ci pour fournir un écoulement en sortie de chambre de mélange (MO) jusque dans la chambre principale (200) ; ou
- en l'absence dudit écoulement de gaz de source (SG), permettre de manière sélective audit écoulement d'air dynamique (RA) dans ladite chambre de mélange (300) de s'écouler jusque dans la chambre principale (200) pour de ce fait fournir un écoulement en sortie de chambre de mélange (MO) ;

ledit écoulement en sortie de chambre de mélange (MO) étant à une troisième température (T3) au moins au niveau de ou à proximité de ladite entrée de chambre principale (220) ;
un système de commande servant à contrôler au moins l'un parmi ledit écoulement d'air dynamique (RA), ledit écoulement de gaz de source (SG) et ledit écoulement en sortie de chambre de mélange (MO) pour fournir une dite troisième température souhaitée (T3) au moins au niveau de ladite entrée de chambre principale (220) ;
dans lequel ladite chambre principale (200) comporte une sortie auxiliaire, et ladite source d'écoulement de gaz (400) comporte un conduit de recirculation raccordant ladite sortie auxiliaire à ladite entrée de chambre de mélange (370) et configuré pour fournir un écoulement d'air de recirculation en provenance de ladite chambre principale (200) jusque dans la chambre de mélange (300) pour de ce fait fournir ledit écoulement de gaz de source (SG).

2. Système selon la revendication 1, dans lequel ledit système de commande (500) fonctionne pour fournir une dite troisième température (T3) de manière à maintenir une température dans ledit volume de contrôle (V) dans les limites d'une gamme prédéfinie des températures de fonctionnement entre une température minimum prédéfinie (T_{min}) et une température maximum prédéfinie (T_{max}).

3. Système (100) selon la revendication 2, dans lequel ladite température minimum prédéfinie (T_{min}) est de -35 °C et dans lequel ladite température maximum prédéfinie est de +55 °C (T_{max}).

4. Système (100) selon l'une quelconque des revendications 1 à 3, comportant l'un parmi :

- un premier capteur de température (SA) dans ladite chambre principale (200) au niveau de ou dans les environs de ladite entrée de chambre principale (220), le premier capteur de température (SA) étant en communication fonctionnelle avec ledit système de commande (500) ; et
- un premier capteur de température (SA) dans ladite chambre principale (200) au niveau de ou dans les environs de ladite entrée de chambre principale (220), le premier capteur de température (SA) étant en communication fonctionnelle avec ledit système de commande (500), et, un deuxième capteur de température (SB) dans ladite chambre principale (200) au niveau de ou dans les environs de ladite sortie de chambre principale (240), le deuxième capteur de température (SB) étant en communication fonctionnelle avec ledit système de commande (500).

5. Système (100) selon la revendication 4, dans lequel ledit système de commande (500) fonctionne pour fournir ladite troisième température souhaitée (T3) basée au moins partiellement sur une température d'entrée détectée (T_A) telle qu'elle a été détectée par ledit premier capteur de température (SA) comprenant au moins l'un parmi les énoncés suivants

- dans lequel le système de commande (500) fonctionne pour augmenter au moins l'un parmi l'écoulement de gaz de source (SG), la deuxième température (T2), et l'écoulement en sortie de chambre de mélange (MO), en réponse à l'une parmi une température d'entrée détectée (T_A) telle qu'elle a été détectée par ledit premier capteur de température (SA) ou une température de sortie détectée (T_B) telle qu'elle a été détectée par ledit deuxième capteur de température (SB) qui atteint ladite température minimum prédéfinie (T_{min}) ;
- dans lequel le système de commande (500) fonctionne pour augmenter au moins l'un parmi l'écoulement de gaz de source (SG), la deuxième température (T2), et l'écoulement en sortie de chambre de mélange (MO), en réponse à l'une parmi une température d'entrée détectée (T_A) telle qu'elle a été détectée par ledit premier capteur de température (SA) ou une température de sortie détectée (T_B) telle qu'elle a été détectée par ledit deuxième capteur de température (SB) qui atteint ladite température minimum prédéfinie (T_{min}), et, dans lequel le système de commande (500) fonctionne pour cesser ladite augmentation d'au moins l'un parmi l'écoulement de gaz de source (SG), la deuxième température (T2), et l'écoulement en sortie de chambre de mélange (MO), en réponse à l'une parmi ladite température d'entrée détectée (T_A) ou ladite température de sortie détectée (T_B) qui est considérablement au-dessus de ladite température minimum prédéfinie (T_{min}) ;
- dans lequel le système de commande (500) fonctionne pour réduire au moins l'un parmi l'écoulement de gaz de source (SG) et la deuxième température (T2), et/ou pour augmenter l'écoulement en sortie de chambre de mélange (MO), en réponse à l'une parmi ladite température d'entrée détectée (T_A) ou ladite température de sortie détectée (T_B) qui atteint ladite température maximum prédéfinie (T_{min}) ;
- dans lequel le système de commande (500) fonctionne pour réduire au moins l'un parmi l'écoulement de gaz de source (SG) et la deuxième température (T2), et/ou pour augmenter l'écoulement en sortie de chambre de mélange (MO), en réponse à l'une parmi ladite température d'entrée détectée (T_A) ou ladite température de sortie détectée (T_B) qui atteint ladite température maximum prédéfinie (T_{max}), et, dans lequel le système de commande (500) fonctionne pour cesser ladite réduction d'au moins l'un parmi l'écoulement de gaz de source (SG) et la deuxième température (T2), et/ou pour cesser ladite augmentation de l'écoulement en sortie de chambre de mélange (MO), en réponse à l'une parmi ladite température d'entrée détectée (T_A) ou ladite température de sortie détectée (T_B) qui est considérablement en dessous de ladite température maximum prédéfinie (T_{max}).

6. Système (100) selon l'une quelconque des revendications 1 à 5, comportant au moins l'une parmi :

- une première pompe variable en mesure d'être contrôlée (450?) connectée de manière fonctionnelle au système de commande (500) et configurée pour faire varier de manière contrôlée la magnitude dudit écoulement de gaz de source (SG) jusque dans ladite chambre de mélange (300) ;
- une deuxième pompe variable en mesure d'être contrôlée (345) connectée de manière fonctionnelle au système de commande (500) et configurée pour faire varier de manière contrôlée la magnitude dudit écoulement en sortie de chambre de mélange (MO) jusque dans ladite chambre principale (200).

7. Système (100) selon la revendication 1, comprenant au moins l'un parmi les énoncés suivants :

- dans lequel ledit écoulement d'air de recirculation est une première proportion dudit écoulement en sortie de chambre de mélange (MO) ;
- dans lequel ledit écoulement d'air de recirculation est une première proportion dudit écoulement en sortie de chambre de mélange (MO), et, dans lequel ladite première proportion est entre 0 % et 100 % dudit écoulement en sortie de chambre de mélange (MO) ;
- dans lequel ledit écoulement d'air de recirculation est une première proportion dudit écoulement en sortie de chambre de mélange (MO), et, dans lequel ladite première proportion est entre 30 % et 70 % dudit écoulement en sortie de chambre de mélange (MO).

8. Système (100) selon l'une quelconque des revendications 1 à 7, comportant un premier système de chauffage (470) accouplé audit conduit de recirculation pour chauffer de manière sélective ledit écoulement d'air de recirculation pour fournir une dite deuxième température souhaitée (T2) audit écoulement de gaz de source (SG).

9. Système (100) selon l'une quelconque des revendications 1 à 8, comprenant au moins l'un des énoncés parmi :

- dans lequel ladite source d'écoulement de gaz (400) comporte une prise d'air dynamique auxiliaire (430A), qui en cours de fonctionnement de celle-ci donne sur l'air atmosphérique, et un conduit auxiliaire (440A) raccordant ladite prise d'air

dynamique auxiliaire (430A) à ladite entrée de chambre de mélange (370), dans lequel ladite prise d'air dynamique auxiliaire (430A) est configurée pour acheminer de manière sélective un écoulement d'air auxiliaire atmosphérique jusque dans la chambre de mélange (300) pour de ce fait fournir ledit écoulement de gaz de source (SG) ;
- dans lequel ladite source d'écoulement de gaz (400) comporte une prise d'air dynamique auxiliaire (430A), qui en cours de fonctionnement de celle-ci donne sur l'air atmosphérique, et un conduit auxiliaire (440A) raccordant ladite prise d'air dynamique auxiliaire (430A) à ladite entrée de chambre de mélange (370), dans lequel ladite prise d'air dynamique auxiliaire (430A) est configurée pour acheminer de manière sélective un écoulement d'air auxiliaire atmosphérique jusque dans la chambre de mélange (300) pour de ce fait fournir ledit écoulement de gaz de source (SG), et, comportant un deuxième système de chauffage (470A) accouplé audit conduit auxiliaire (440A) pour chauffer de manière sélective ledit écoulement d'air auxiliaire atmosphérique pour fournir une dite deuxième température souhaitée (T2) audit écoulement de gaz de source (SG) ;
- dans lequel ladite source d'écoulement de gaz (400) comporte un réservoir de gaz sous pression (430B), et un conduit de réservoir (440B) raccordant ledit réservoir de gaz sous pression (430B) à ladite entrée de chambre de mélange (370) et configuré pour fournir un écoulement de gaz sous pression jusque dans la chambre de mélange pour de ce fait fournir ledit écoulement de gaz de source (SG) ;
- dans lequel ladite source d'écoulement de gaz (400) comporte un réservoir de gaz sous pression (430B), et un conduit de réservoir (440B) raccordant ledit réservoir de gaz sous pression (430B) à ladite entrée de chambre de mélange (370) et configuré pour fournir un écoulement de gaz sous pression jusque dans la chambre de mélange (300) pour de ce fait fournir ledit écoulement de gaz de source (SG), et, comportant un troisième système de chauffage (470B) accouplé audit conduit de réservoir (440B) pour chauffer de manière sélective ledit écoulement de gaz sous pression pour fournir une dite deuxième température souhaitée (T2) audit écoulement de gaz de source (SG) ;
- dans lequel ladite chambre principale (200) reçoit des composants électroniques ;
- dans lequel ladite chambre principale (200) reçoit des composants électroniques, et dans lequel lesdits composants sont opérationnels dans les limites de ladite gamme prédéfinie des températures.

10. Système (100) selon l'une quelconque des revendications 1 à 9, comportant par ailleurs une prise d'air dynamique principale (399), qui en cours de fonctionnement de celle-ci donne sur l'air atmosphérique, et un conduit dynamique (396) raccordant ladite prise d'air dynamique principale (399) à ladite entrée d'air dynamique (360), dans lequel ladite prise d'air dynamique principale (399) est configurée pour acheminer de manière sélective ledit écoulement d'air dynamique (RA) jusque dans ladite chambre de mélange (300).

11. Véhicule aérien comportant le système (100) selon l'une quelconque des revendications 1 à 10, et dans lequel éventuellement le véhicule aérien est un véhicule aérien sans pilote.

12. Procédé servant à fournir une température contrôlée dans un volume de contrôle (V), le volume de contrôle (V) étant défini par une chambre principale (200) ayant au moins une entrée de chambre principale (220), une sortie de chambre principale (240), et une sortie auxiliaire, le procédé comportant les étapes consistant à :

(A) fournir un écoulement d'air dynamique (RA) à une première température (T1) jusque dans une chambre de mélange (300) par le biais d'une entrée d'air dynamique (360), la chambre de mélange (300) ayant une sortie de chambre de mélange (340) en communication fluidique sélective avec l'entrée de chambre principale (220), et au moins une entrée de chambre de mélange (370), et dans lequel l'entrée d'air dynamique (360) est différente par rapport à ladite au moins une entrée de chambre de mélange (370) ;
(B) fournir de manière sélective un écoulement de gaz de source (SG) à une deuxième température (T2) jusque dans ladite chambre de mélange (300), ladite deuxième température (T2) étant supérieure par rapport à ladite première température (T1) ; et dans lequel se trouvent les étapes consistant à :

- en présence dudit écoulement de gaz de source (SG) dans ladite chambre de mélange (300), permettre de manière sélective audit écoulement d'air dynamique (RA) et audit écoulement de gaz de source (SG) dans ladite chambre de mélange (300) de se mélanger dans celle-ci pour fournir un écoulement en sortie de chambre de mélange (MO) jusque dans le volume de contrôle (V) ; ou
- en l'absence dudit écoulement de gaz de source (SG), permettre de manière sélective audit écoulement d'air dynamique (RA)

dans ladite chambre de mélange (300) de s'écouler jusque dans le volume de contrôle (V) pour de ce fait fournir un écoulement en sortie de chambre de mélange (MO) ;
ledit écoulement en sortie de chambre de mélange (MO) étant à une troisième température (T3) au moins au niveau de ou à proximité de l'entrée donnant dans le volume de contrôle (V) ;

(C) contrôler au moins l'un parmi ledit écoulement d'air dynamique (RA), ledit écoulement de gaz de source (SG) et ledit écoulement en sortie de chambre de mélange (MO) pour fournir une dite troisième température souhaitée (T3) au moins au niveau de ou à proximité de l'entrée donnant dans le volume de contrôle (V) ; et
(D) fournir un écoulement d'air de recirculation en provenance du volume de contrôle (V) jusque dans la chambre de mélange (300) par le biais d'un conduit de recirculation pour de ce fait fournir ledit écoulement de gaz de source (SG), dans lequel ledit conduit de recirculation raccorde ladite sortie auxiliaire à ladite entrée de chambre de mélange (370).

13. Procédé selon la revendication 12, comprenant au moins l'un parmi les énoncés suivants :

- dans lequel ladite troisième température (T3) est telle qu'elle maintient une température dans ledit volume de contrôle (V) dans les limites d'une gamme prédéfinie des températures de fonctionnement (R?) entre une température minimum prédéfinie (T_{min}) et une température maximum prédéfinie (T_{max}) ;
- dans lequel ladite troisième température (T3) est telle qu'elle maintient une température dans ledit volume de contrôle (V) dans les limites d'une gamme prédéfinie des températures de fonctionnement (R?) entre une température minimum prédéfinie (T_{min}) et une température maximum prédéfinie (T_{max}), et, dans lequel ladite température minimum prédéfinie (T_{min}) est de -35 °C et dans lequel ladite température maximum prédéfinie (T_{max}) est de +55 °C.

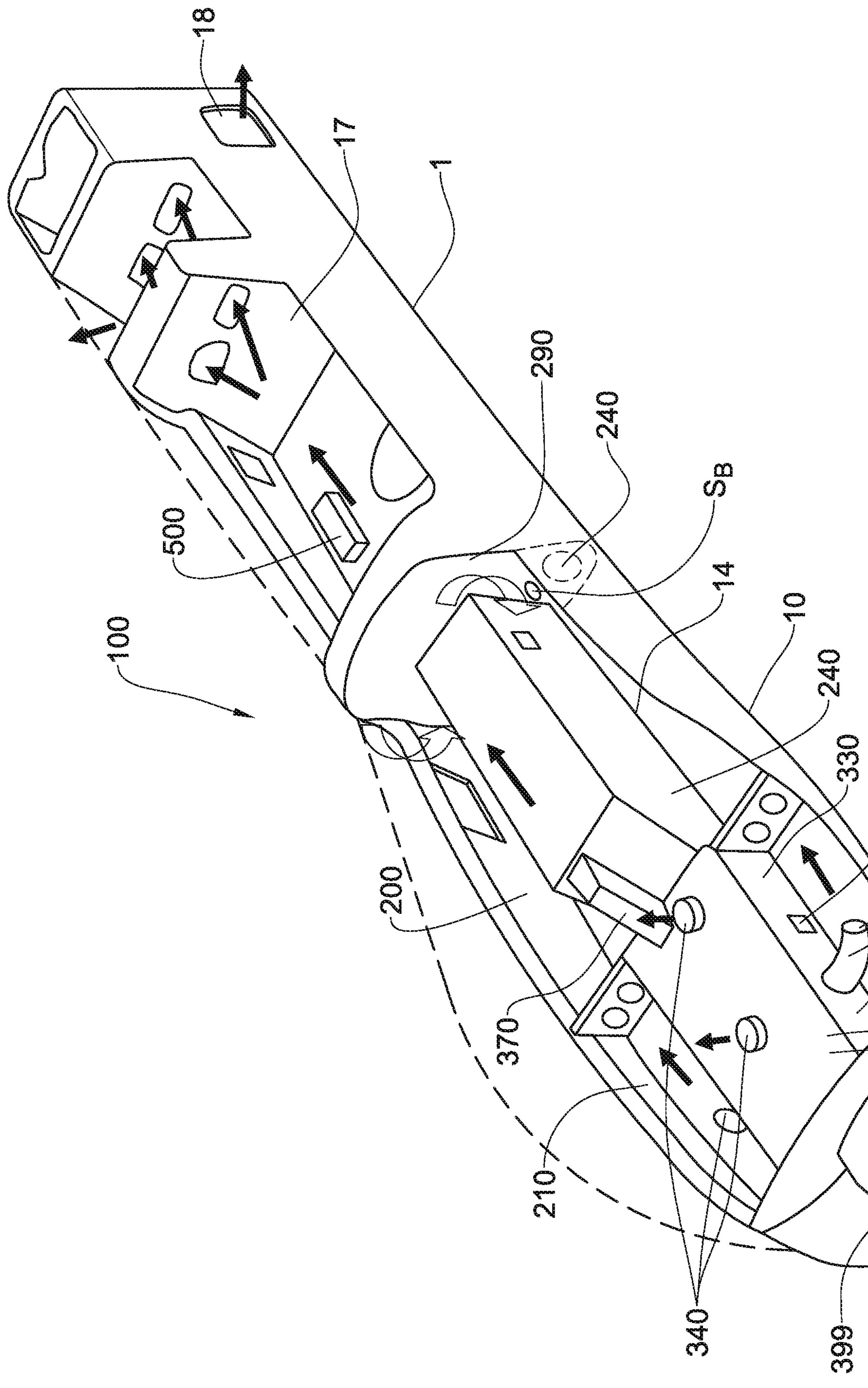
14. Procédé selon l'une quelconque des revendications 12 à 13, comprenant au moins l'une parmi les étapes suivantes consistant à :

- fournir une source de chauffage et, au moyen de la source de chauffage, chauffer de manière contrôlée ledit écoulement de gaz de source (SG) à une dite deuxième température souhaitée (T2) ;
- fournir une dite troisième température souhaitée (T3) basée au moins partiellement sur une température d'entrée détectée (T_A) telle qu'elle a été détectée au niveau de ou dans les environs d'une d'entrée du volume de contrôle (V) ;
- fournir une dite troisième température souhaitée (T3) basée au moins partiellement sur une température de sortie détectée (T_B) telle qu'elle a été détectée au niveau de ou dans les environs d'une sortie du volume de contrôle (V) ;
- fournir une dite troisième température souhaitée (T3) basée au moins partiellement sur une température de sortie détectée (T_B) telle qu'elle a été détectée au niveau de ou dans les environs d'une sortie du volume de contrôle (V), et, augmenter au moins l'un parmi l'écoulement de gaz de source (SG), la deuxième température (T2), et l'écoulement en sortie de chambre de mélange (MO), en réponse à l'une parmi ladite température d'entrée détectée (T_A) ou ladite température de sortie détectée (T_B) qui atteint ladite température minimum prédéfinie (T_{min}) ;
- fournir une dite troisième température souhaitée (T3) basée au moins partiellement sur une température de sortie détectée (T_B) telle qu'elle a été détectée au niveau de ou dans les environs d'une sortie du volume de contrôle (V), et, augmenter au moins l'un parmi l'écoulement de gaz de source (SG), la deuxième température (T2), et l'écoulement en sortie de chambre de mélange (MO), en réponse à l'une parmi ladite température d'entrée détectée (T_A) ou ladite température de sortie détectée (T_B) qui atteint ladite température minimum prédéfinie (T_{min}), et, cesser ladite augmentation d'au moins l'un parmi l'écoulement de gaz de source (SG), la deuxième température (T2), et l'écoulement en sortie de chambre de mélange (MO), en réponse à l'une parmi ladite température d'entrée détectée (T_A) ou ladite température de sortie détectée (T_B) qui est considérablement au-dessus de ladite température minimum prédéfinie (T_{min}) ;
- fournir une dite troisième température souhaitée (T3) basée au moins partiellement sur une température de sortie détectée (T_B) telle qu'elle a été détectée au niveau de ou dans les environs d'une sortie du volume de contrôle (V), et, réduire au moins l'un parmi l'écoulement de gaz de source (SG) et la deuxième température (T2), et/ou augmenter l'écoulement en sortie de chambre de mélange (MO), en réponse à l'une parmi ladite température d'entrée détectée (T_A) ou ladite température de sortie détectée (T_B) qui atteint ladite température maximum prédéfinie (T_{max}) ;
- fournir une dite troisième température souhaitée (T3) basée au moins partiellement sur une température de sortie détectée (T_B) telle qu'elle a été détectée au niveau de ou dans les environs d'une sortie du volume de contrôle (V), et, ré-

duire au moins l'un parmi l'écoulement de gaz de source (SG) et la deuxième température (T2), et/ou augmenter l'écoulement en sortie de chambre de mélange (MO), en réponse à l'une parmi ladite température d'entrée détectée (T_A) ou ladite température de sortie détectée (T_B) qui atteint ladite température maximum prédéfinie (T_{max}), et, cesser ladite réduction d'au moins l'un parmi l'écoulement de gaz de source (SG) et la deuxième température (T2), et/ou cesser ladite augmentation de l'écoulement en sortie de chambre de mélange (MO), en réponse à l'une parmi ladite température d'entrée détectée (T_A) ou ladite température de sortie détectée (T_B) qui est considérablement en dessous de ladite température maximum prédéfinie (T_{max}) ;

- faire varier de manière contrôlée la magnitude dudit écoulement de gaz de source (SG) jusque dans ladite chambre de mélange (300) ;
- faire varier de manière contrôlée la magnitude dudit écoulement en sortie de chambre de mélange (MO) jusque dans le volume de contrôle (V) ;
- acheminer de manière sélective un écoulement d'air auxiliaire atmosphérique jusque dans la chambre de mélange (300), différent par rapport audit écoulement d'air dynamique (RA), pour de ce fait fournir ledit écoulement de gaz de source (SG) ;
- fournir un écoulement de gaz sous pression jusque dans la chambre de mélange (300) pour de ce fait fournir ledit écoulement de gaz de source (SG) ;
- dans lequel le volume de contrôle (V) reçoit des composants électroniques.

15. Procédé selon la revendication 12, dans lequel ledit écoulement d'air de recirculation est une première proportion dudit écoulement en sortie de chambre de mélange (MO), et dans lequel ladite première proportion est entre 30 % et 70% dudit écoulement en sortie de chambre de mélange (MO) .



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S_B
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S_A
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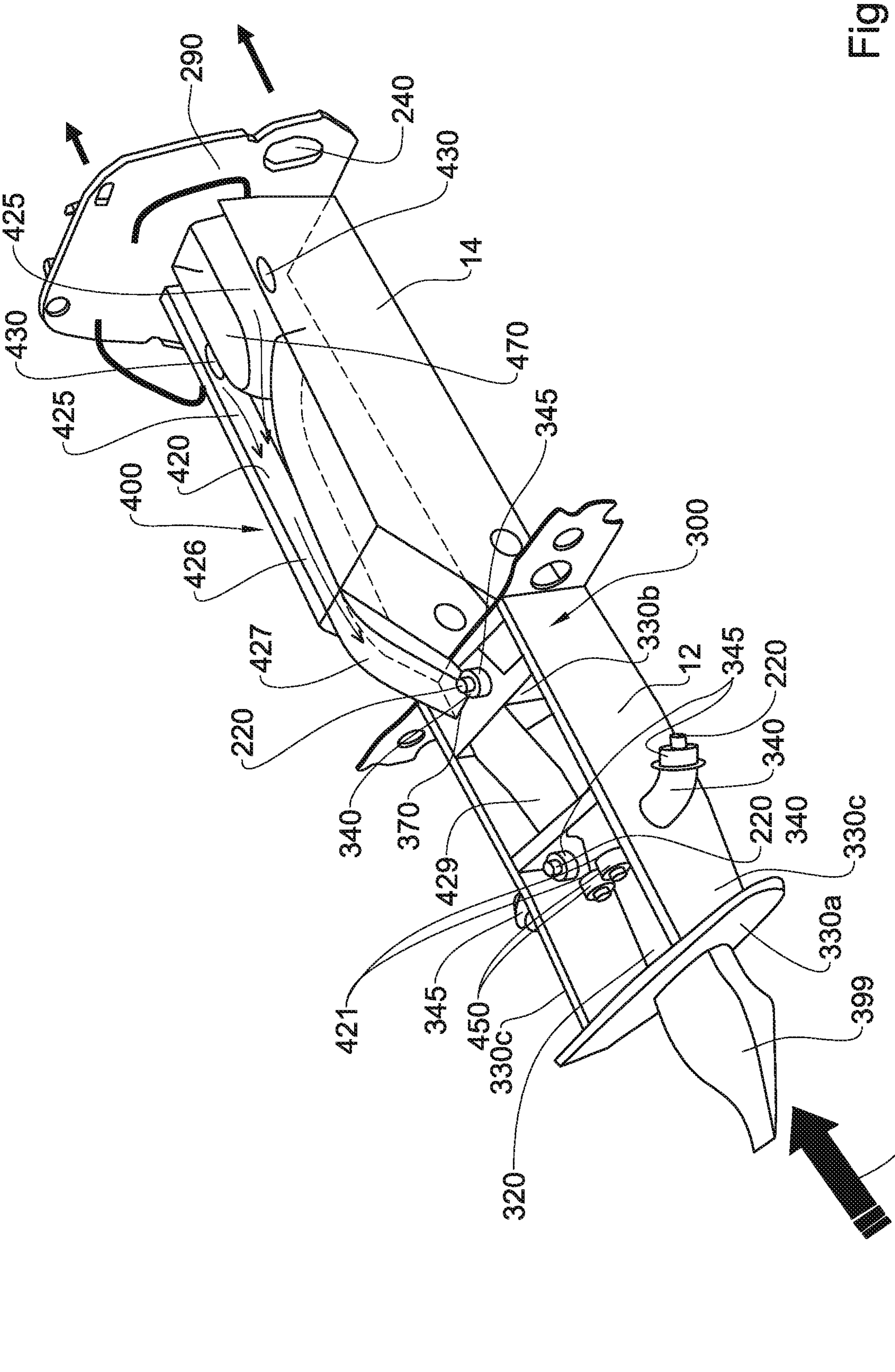
230
210
340
399

Fig. 1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340
429
220
340
330c
330a
421
345
450
330c
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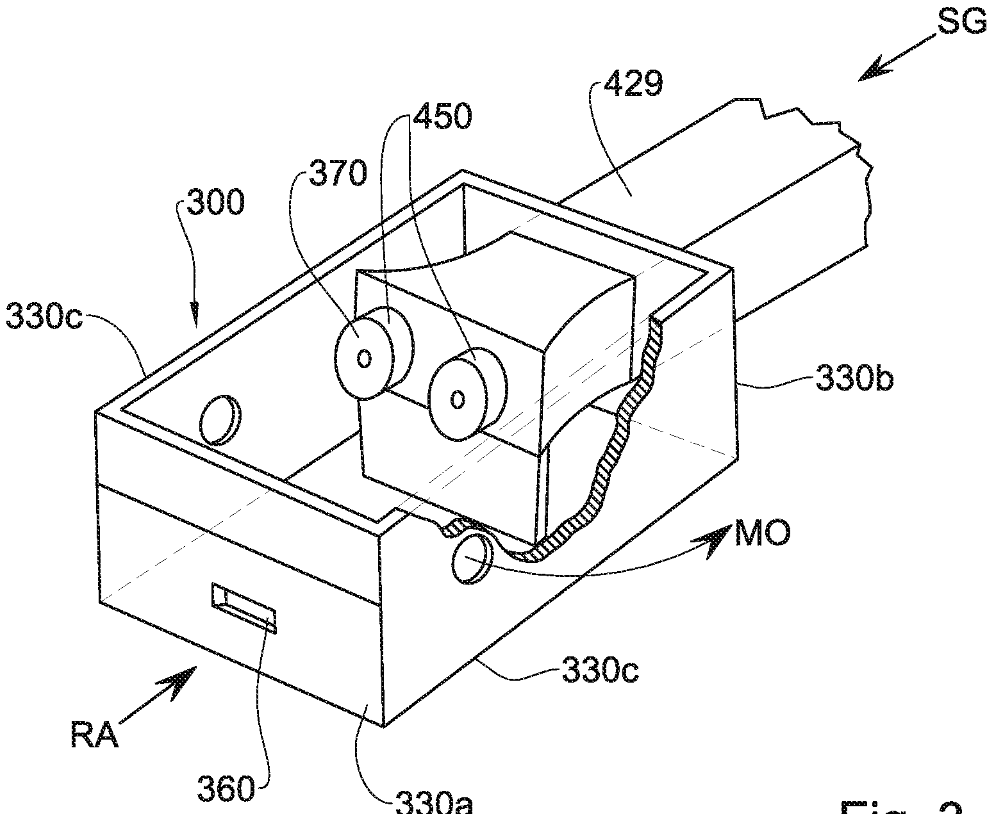
RA

Fig. 2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RA
360
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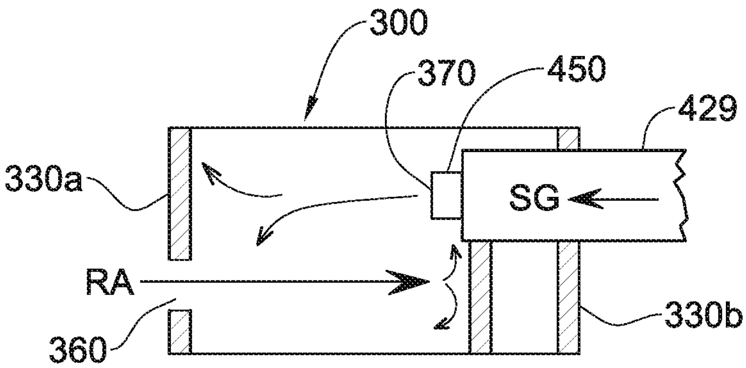
Fig. 3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429
330a
SG
RA
330b
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Fig. 3(a)

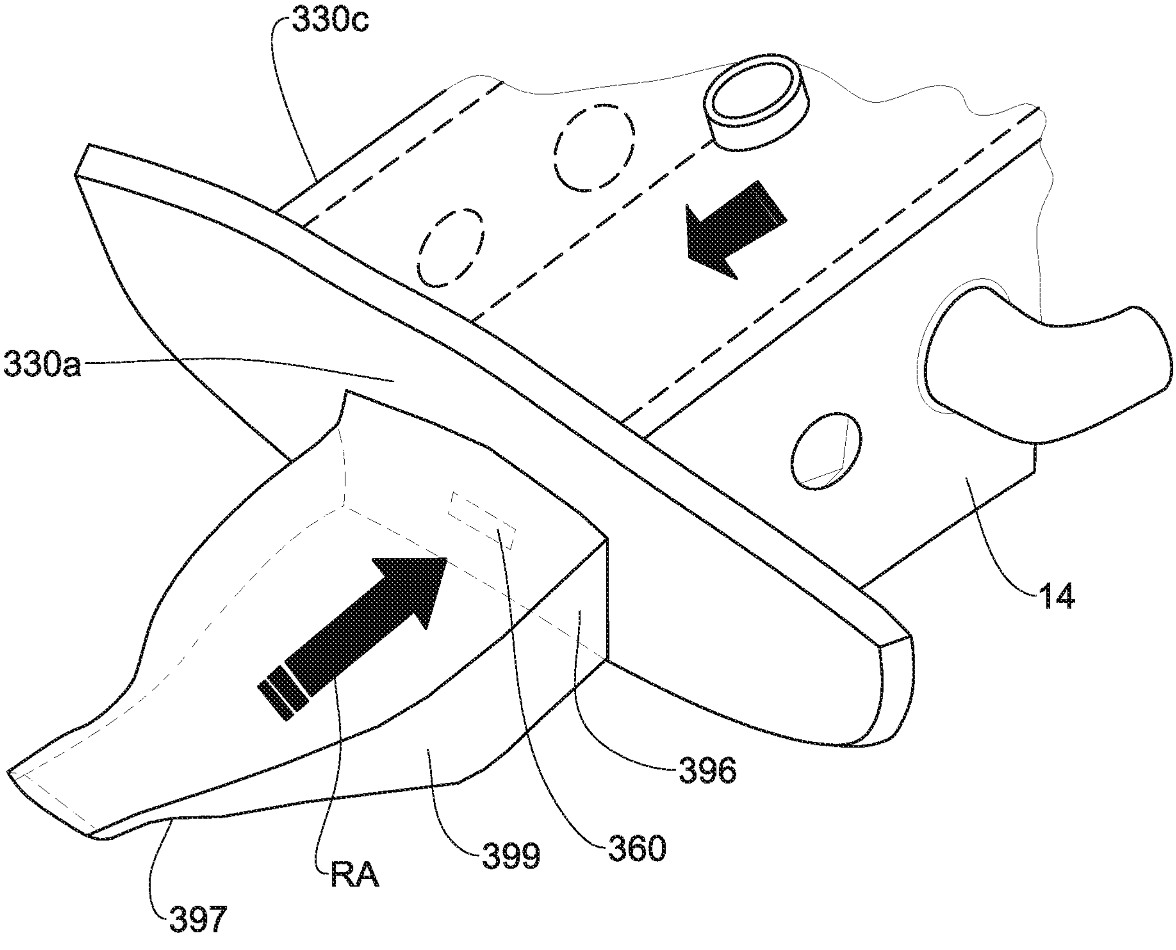
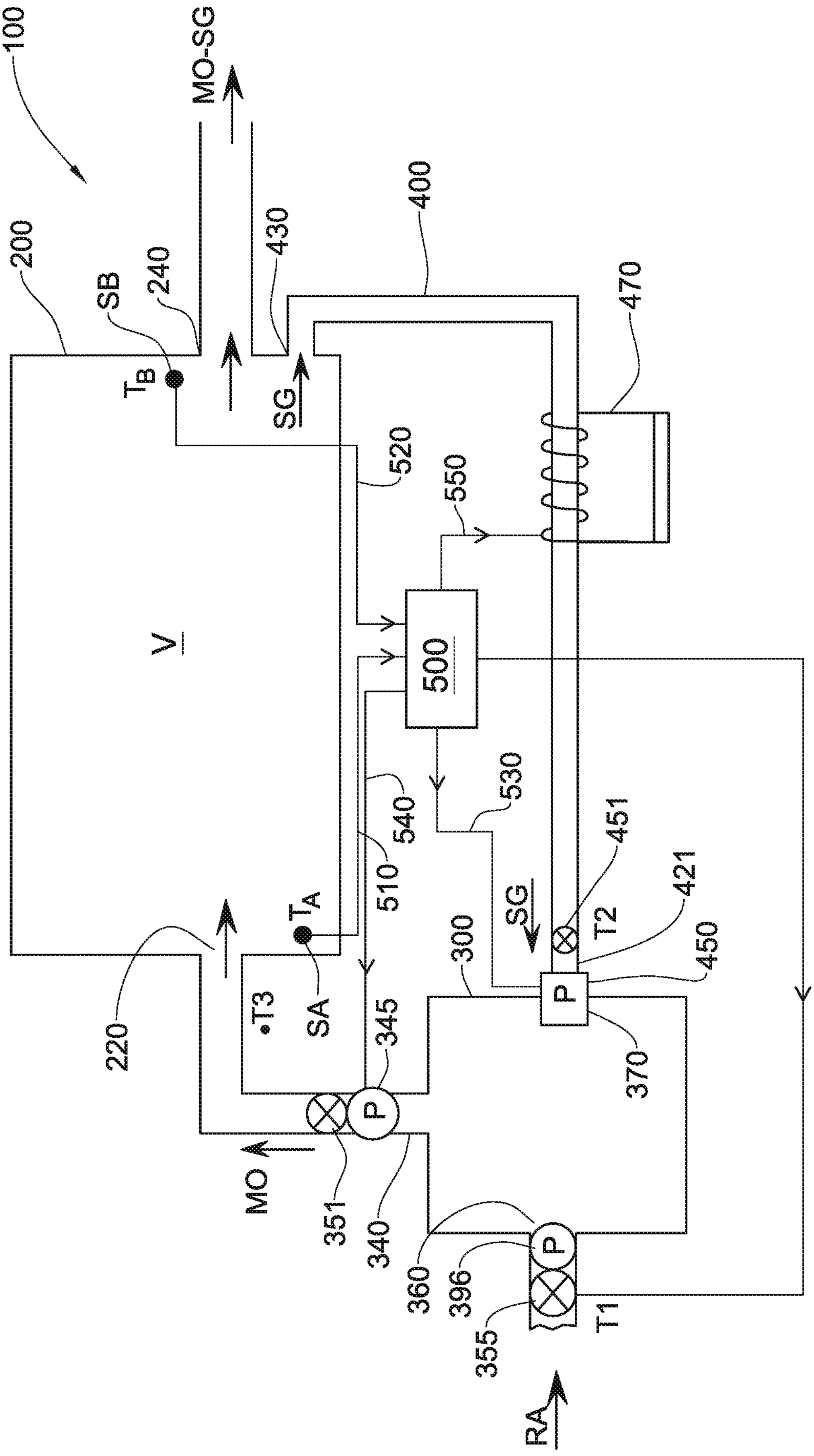


Fig. 4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421
SG
T2
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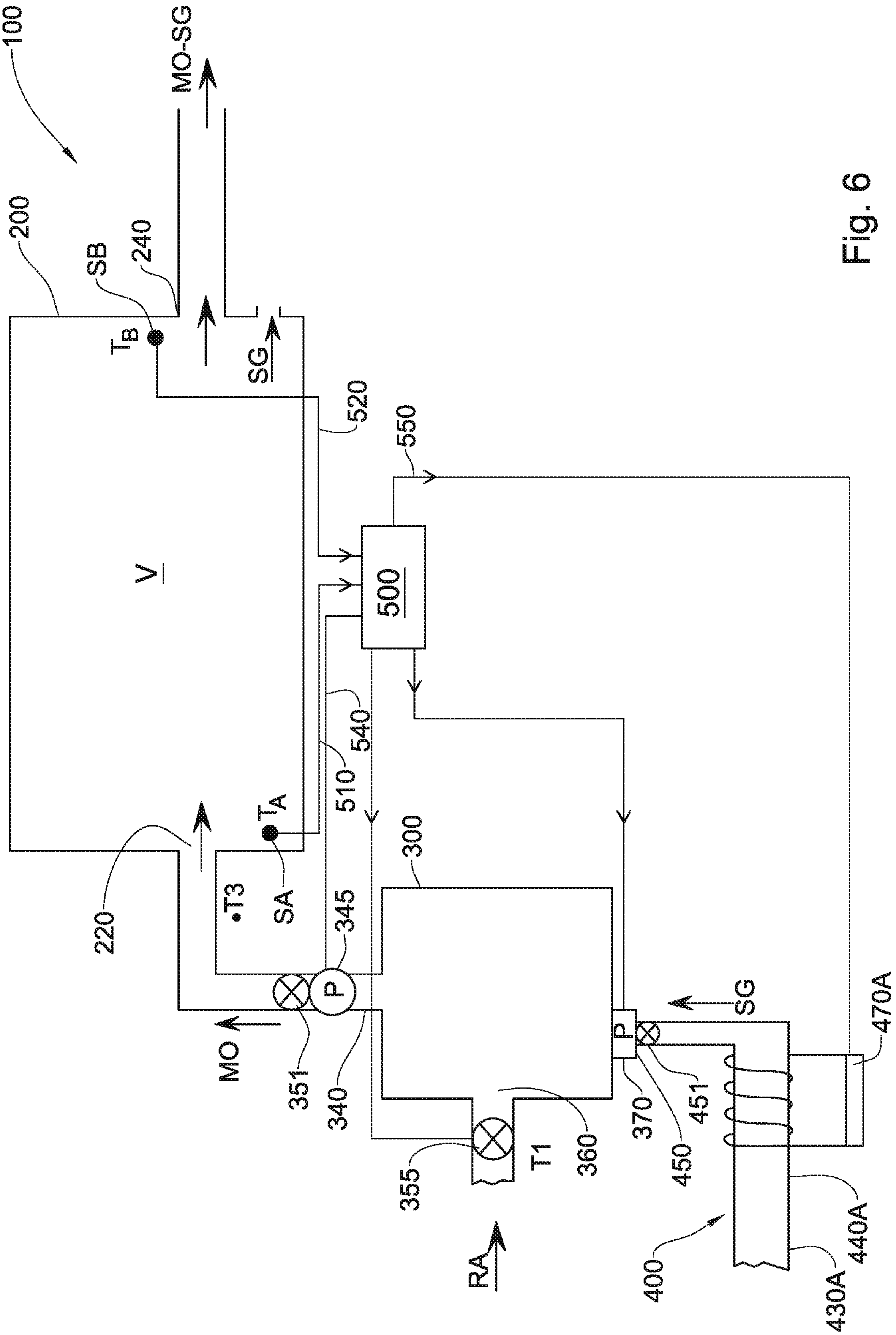
220
T3
SA
345
P
P
P
MO
351
340
360
396
355
T1
RA

Fig. 5



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SG
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470A
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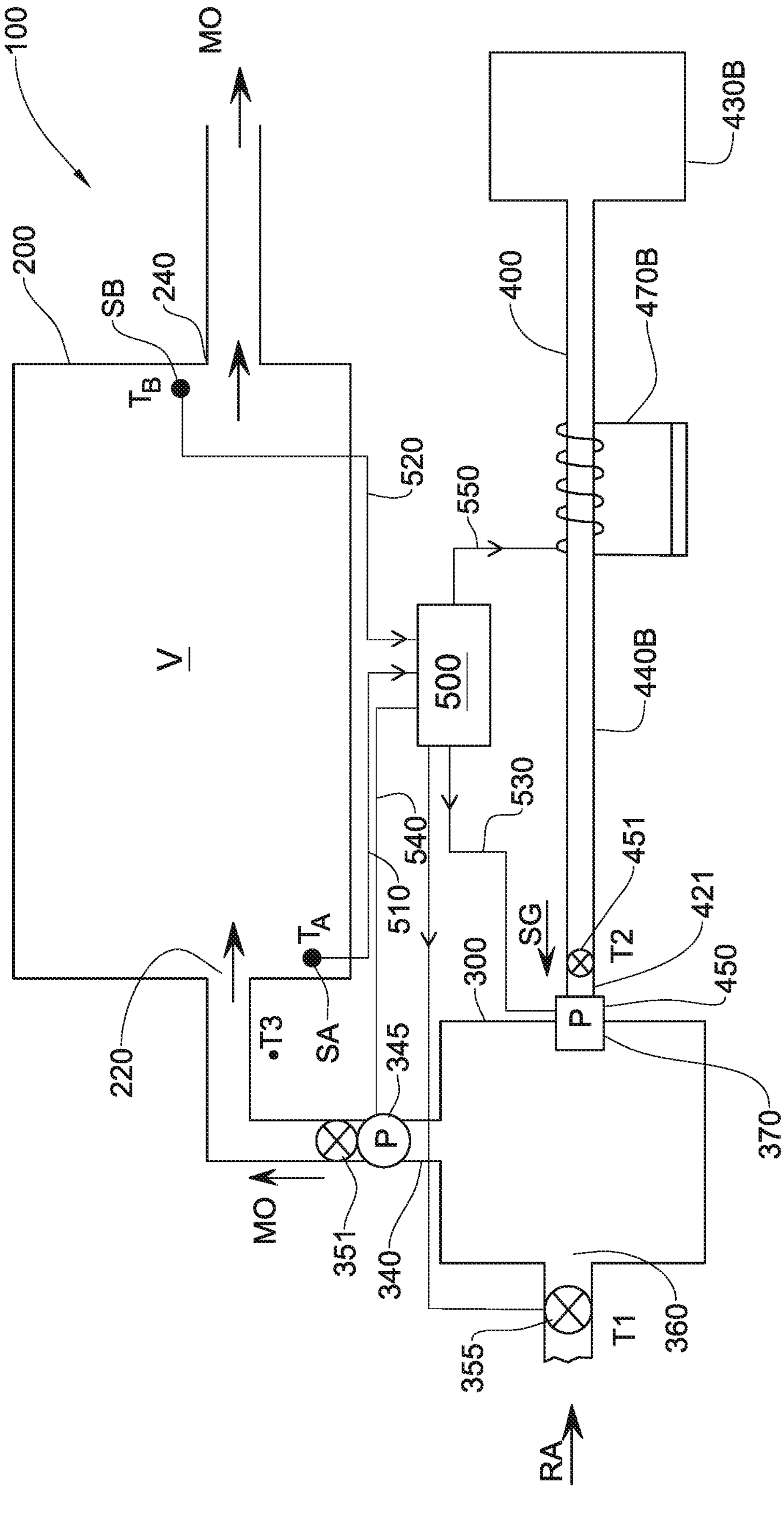
440A
RA

Fig. 6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T1
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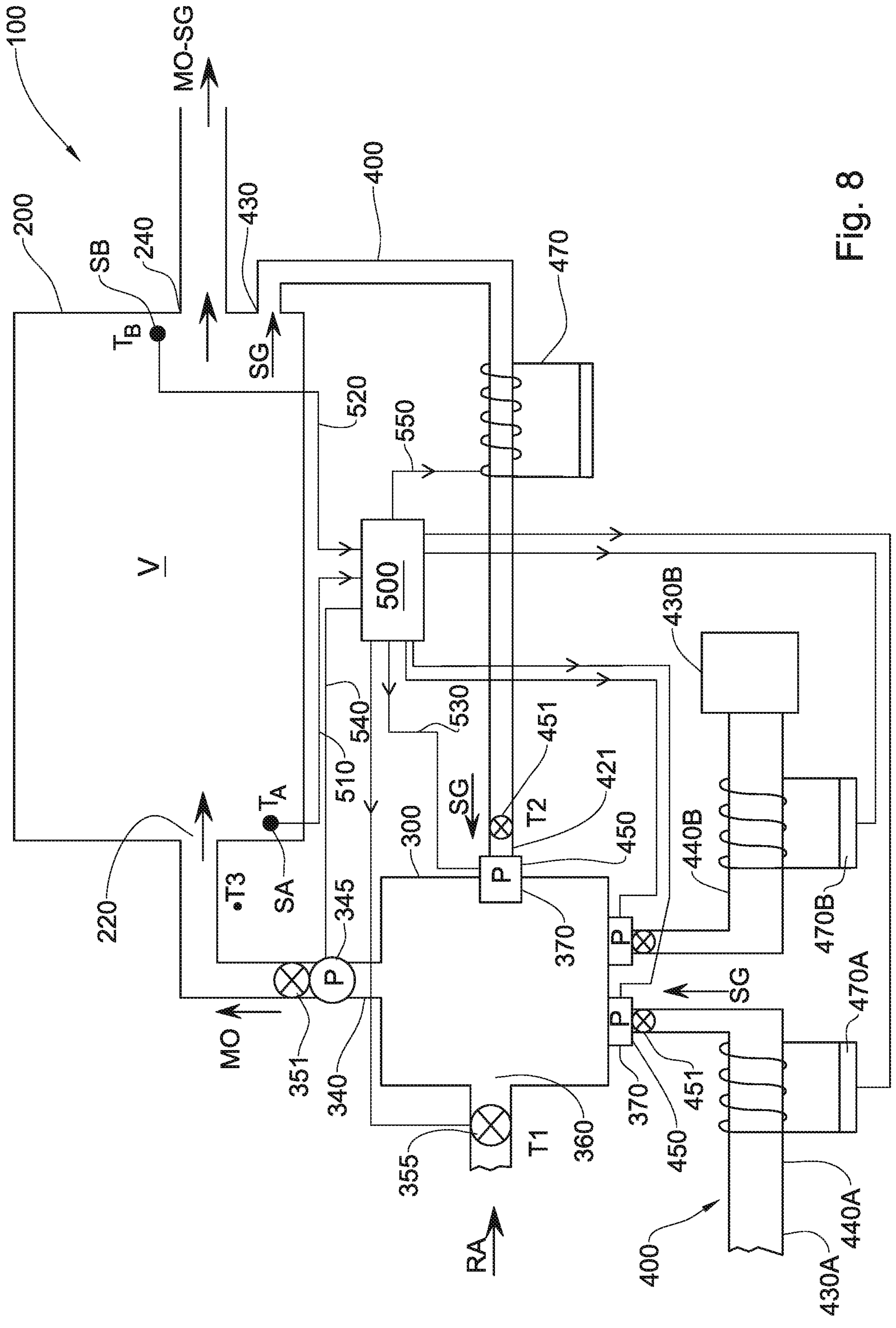
RA

Fig. 7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470B
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SG
MO
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340
360
370
451
450
T1
355
RA
400
430A
440A

Fig. 8

REFERENCES CITED IN THE DESCRIPTION

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